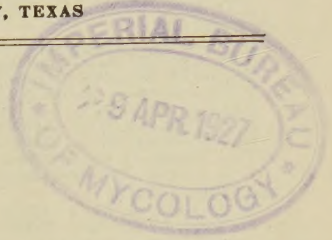


TEXAS AGRICULTURAL EXPERIMENT STATION

B. YOUNGBLOOD, DIRECTOR

COLLEGE STATION, BRAZOS COUNTY, TEXAS



THIRTY-NINTH ANNUAL REPORT 1926



AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

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V. P. LEE, Ph. D., *Professor of Marketing and Finance*
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†As of March 1, 1927.

*On leave of absence.

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***In cooperation with U. S. Department of Agriculture.

****In cooperation with the School of Agriculture.

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THIRY-NINTH ANNUAL REPORT

1926

A. B. CONNER, Acting Director

The Texas Agricultural Experiment Station was established in 1886, and is the agricultural research division of the Agricultural and Mechanical College of Texas. This division of the College is unique, in that it serves not only the teaching and extension divisions of the parent institution, but also every institution and agency within the borders of the State engaged in the dissemination of reliable agricultural information. It is, therefore, rendering to the various agricultural institutions and agencies of the State a service of fundamental importance. Not only does the Texas Agricultural Experiment Station serve these institutions and agencies by giving them reliable agricultural information for use in teaching and dissemination, but it also serves the farmer and other citizens by making available to them agricultural information obtained under Texas conditions and thus directly available for practical application. Still another service rendered is the development and introduction of new and superior crop strains, new blood lines in animals, and new methods and practices that can be used advantageously in developing the agricultural resources of the State.

The Texas Agricultural Experiment Station System at the present time consists of seventeen divisions concerned with different lines of scientific investigation. Extensive indoor and outdoor laboratories are available for the use of these different divisions. There are also fifteen substations and also six field laboratories devoted to the study of specific problems in the principal agricultural regions of the State. Through its system of substations, the agricultural problems of the several important regions may be studied under local conditions. Thus the Texas Agricultural Experiment Station, through its extensive organization, each unit of which is designed for a specific purpose, is serving the agricultural needs of the State, with the definite objective of contributing applicable facts, suitable crops and crop strains, superior blood lines, and methods and practices which will result in an increasing agricultural wealth.

SOME ACCOMPLISHMENTS

The Texas Agricultural Experiment Station has rendered many important services to the people of Texas through the development of research projects.

It has developed the Texas fever immunization process, by use of which, in a period of a few years, the best cattle blood lines in the country have been introduced into our herds, completely replacing the old

type of Longhorn cattle and increasing the wealth of the cattle industry accordingly.

It has introduced Sudan grass and many other useful grazing and hay plants. It has introduced and developed superior producing strains of grain sorghum, thus giving to Texas a basic grain crop for West and Northwest Texas, so necessary to the support of these regions as farming sections. It has contributed much information as to the methods and practices in growing maximum yields of these grains under existing conditions; it has determined the feeding value of these grain sorghums, and found that they are approximately equal to corn, pound for pound, thus opening up one of the great potential live stock feeding areas in the nation.

It has discovered that feeding a small amount of bone meal daily to cattle grazing on certain non-calcareous soils increases the effectiveness and the profitableness of the grazing.

It has developed Denton wheat and Nortex oats, two strains of small grain with superior producing qualities.

It has aided in the development of cotton growing in Northwest Texas, this work extending over a period of fifteen years, in which the Agricultural Experiment Station has taken an active part, with the result that cotton is now grown as a dependable crop in the Plains region. It has developed an early-maturing cotton known as Westex, which promises to extend the cotton growing region 75 to 100 miles north and west of its present limits.

It has contributed much information relative to fertilizing and spacing practices, crop rotation, and general practices suitable for the principal regions of the State.

Not only has the Experiment Station rendered service in the matter of aiding the farmers to produce more efficiently, but it has been engaged during the past six years in the study of some of the economic difficulties confronting the producer. These studies have been concerned chiefly with the proper adjustment of the farming program to enable the grower to best utilize his time and otherwise minimize the cost of production. These studies have developed the fact that in so far as economical production is concerned, Texas, by reason of its natural resources, occupies an enviable position and can produce farm crops with great economy.

The Experiment Station has made studies of long and short-time farm and ranch credits, has published some information in this regard and is continuing this work. It is also studying the marketing of farm products, particularly cotton, vegetables, and dairy products, dealing chiefly with those phases of study having to do with a satisfactory disposal of the product on such a basis that the grower may receive the benefit of the high quality of product produced.

The Experiment Station is now organizing a Division of Rural Home Research for the purpose of studying the rural home problems, looking to the development and improvement of our rural homes and rural life.

OPPORTUNITY FOR RESEARCH

No other experiment station or agricultural and mechanical college in the United States is confronted with such a vast array of opportunities to render service to so many distinct and varied regions as is the case in Texas. There are several soil regions derived from varying geological formations presenting a complexity of soils and soil conditions not found in any other state. The climatic conditions vary widely. The belts of rainfall vary from 60 inches to less than 10 inches annually. The altitude ranges from sea level to more than 4000 feet. The latitude ranges from that of Southern Florida to that of Southern Missouri. The growing season and the native vegetation all vary widely in different regions so that altogether the agricultural problems have to be studied from a standpoint of distinct agricultural regions.

That such a range of varying agricultural conditions should exist is due in a large measure to the largeness of the State and to the geographical location. In order to appreciate the vast opportunity for agricultural research in Texas in relation to the development of the resources of the State, it is necessary to compare, for example, one of these principal regions alone with some of our leading states. The area of the Blacklands region alone comprises 23,437 square miles as compared with the total area of the State of Indiana of 36,045 square miles; 40,740 square miles in Ohio; 55,586 square miles in Iowa; 56,043 square miles in Illinois, and 68,727 square miles in Missouri. Similar comparisons could be made for other agricultural regions in Texas, some of which are even larger than the Blacklands; thus it may be seen that there are in Texas distinct agricultural regions that range from approximately the size of the State of Indiana to half the size of the State of Iowa. The total area of the States of Ohio, Indiana, Iowa, Illinois, and Missouri are equal to only 97.56 per cent of the total area of the State of Texas and if these five states comprising the heart of the Corn Belt were grouped into a single state the variation in the conditions of soil and climate would in nowise approach the diversity that exists in Texas. It is obvious, therefore, that Texas problems are many and complex and in this diversity and complexity of problems there exists an unusual opportunity in research for developing basic facts, basic information, suitable crops, adaptable live stock blood lines, and methods and practices which have a definite relation to the full development of the agricultural wealth of Texas. The development of the agricultural resources of Texas is largely dependent on the development of agricultural research. Texas has large areas of potential farming land as yet undeveloped.

The soils and climatic conditions in a large part of Texas lend themselves to the institution of economies in production not possible under other conditions. This is particularly true in cutting the cost of producing the crop and likewise in harvesting it. These economies are

by no means fully developed at the present time and their full development seems to rest on the necessary basic information.

Runoff Water Losses and Soil Erosion

Since in nearly every region of Texas water is a limiting factor in crop production and since we know that by certain methods and practices water conservation can be effectively practiced by the individual farmer, a great field for research lies before us in Texas in developing information as to the extent to which losses of water by run-off occur on our farm lands in the different soil types and in regions of different climatic conditions, together with studies to determine the most effective means of checking these losses. The characteristic downpours of rain so common in the West occur in most parts of Texas and contribute heavily to losses of water which seem to be avoidable in a large measure if suitable methods can be developed for effective means of holding the water on the land. This phase of research having to do with the conservation of water on the land where it falls involves the accumulation and application of information on the character of rainfall, the nature of the losses, and the different types of effective obstructions. It has a direct bearing on the whole conservation problem of Texas because it is one means of keeping out of the streams a surplus flow of water which is ordinarily lost to the farmer and which carries immense quantities of soil and plant food to the sea, thus depleting soil fertility and causing disastrous hazards to fertile areas along the principal streams.

Texas Feeds for Texas Livestock

Another fertile field for research lies in the study and utilization of our resources for live stock feeding. Texas has more than five million cattle, more than a million mules, nearly two million goats, three and one-half million sheep, and three-quarters of a million hogs. On the other hand, Texas produced in 1924, according to the preliminary report in the 1924 Yearbook of the United States Department of Agriculture, 78,200,000 bushels of corn, 48,892,000 bushels of oats, 45,375,000 bushels of grain sorghum, 2,118,000 tons of cotton seed, 111,000 tons of alfalfa, 844,000 tons of tame hay, 215,000 tons of wild hay, 25,826,000 bushels of wheat, and 3,220,000 bushels of barley, to say nothing of the immense tonnage of forage utilized in the form of grass and grazing for the unusually large live stock population of the State. With these resources not yet fully developed, it would seem that an unusual opportunity for research exists in the study of live stock feeding, not only from the standpoint of the gains made but also from the standpoint of the quality of meat produced. Moreover, the feeding possibilities as they exist in the different agricultural regions of Texas ought to be well understood and the best means ought to be known as to the utilization of our diverse feed resources as they exist, and this information can only be obtained through research as a means of developing sound

and reliable facts concerning this wealth of natural resources and natural advantages. It is well known that Texas ships out annually to the Corn Belt thousands of head of cattle to be fed and fattened. West Texas produces large crops of grain sorghum, which should be fed at a profit in that locality to cattle now shipped to other states. A better knowledge and a better understanding of the advantages which we enjoy would enable us to avoid this economic loss.

Peculiar Fertilizer Problems in Texas

There is a great opportunity for developing our agricultural resources by research in regard to soil fertility. There are many complex problems affecting the fertility of the soil in the West which seem to hold in abeyance any unusual accomplishments in this direction until such time as a more complete understanding of the factors affecting soil fertility is secured. A summary of all the research work done in the West indicates that under the existing conditions of limited water supplies, we do not fully understand the processes affecting the fertility of the soil. It is necessary to understand more fully the chemical changes that go on in the soil under our peculiar conditions and it is necessary to know more about the bacteriological organisms in the soil which may in number or in variety have some relation to soil fertility. These and other fundamental things must become well understood through research before we can formulate the underlying principles of soil fertility and lay down the most effective and most practical means of maintaining the fertility of the soil. It is well known that soil fertility is intimately associated both with the cost of production and with the quality of the product produced.

Expansion Desirable in Cotton Root-rot Studies

Unusual opportunities present themselves to Texas in the development of an aggressive research program in the study of plant diseases affecting the crops grown in different parts of the State. The cotton root-rot disease alone has during this past year caused losses running into millions of dollars to Texas farmers, either by losses in cutting down production or by losses which affect the cost of producing a bale of cotton. The cotton root-rot disease has been studied for nearly forty years in Texas, but until recently in a desultory sort of fashion. Perhaps in the early development of these studies it was well to proceed slowly, but with the mass of information available at the present time, there seems reason to believe that an aggressive program for cotton root-rot studies for a period of, say, five years will yield information leading to much more effective means of controlling cotton root-rot disease than exist at the present time. Considering the tremendous losses sustained annually, any reasonable amount of money expended over a period of years would seem fully justifiable, looking at the situation from the standpoint of a business enterprise.

Losses to Crops and Livestock Due to Insects

Insects cause heavy losses annually not only to crops but also to live stock. That these losses can be greatly reduced is beyond question. It is necessary, however, if we are to prevent these losses, to know the life history of the insect involved and the manner in which it reacts to varying conditions. When these things are known and only when they are known will the citizen be able to combat insect life most successfully. Take, for example, the depredations of the cotton flea hopper, an insect which until very recently was not known to damage cotton; it immediately becomes necessary to aggressively undertake research concerning the life history of this insect, including the different life stages through which it passes, the number of broods involved, and when these broods appear, the host plants or food plants which may harbor the insect, the time it goes into hibernation, how successfully it over-winters and when it emerges, and the environmental conditions which may promote or retard its development and activities. Likewise, there are many insect depredations upon live stock which must be studied in a similarly detailed way if we are to understand how to fully control them. This research in the field of insect life is fundamental to the successful combating of these pests.

Horticulture on Every Farm

There is vast promise in the horticultural possibilities of Texas, including the pecan and any other nut-bearing trees, citrus, peaches, plums, jujubes, and other fruit-bearing trees and shrubs, and the numerous vegetable crops. The problems in connection with the production of these horticultural crops in commercial quantities are many and require definite knowledge as to the varieties best suited to the different sections and the best methods and practices of producing both quantity and quality. Aside from the relation of research to commercial production, there remains a field of horticulture which is even larger. This field of endeavor has to do with the utilization of horticultural crops on farms for home use and providing food for the family. Texas has 436,033 farms (1920 census). Each of these farms should produce for home use a quantity of horticultural crops embracing fruits, nuts, berries, and vegetables. On account of the variety of conditions existing, the variety of horticultural crops available to the individual farmer depends very largely upon our knowledge of the horticultural possibilities of the different regions of Texas from the standpoint of home use and not from the standpoint of production for sale. This field of research requires intensive study. Although home vegetables and fruits may not yield a large amount of money, they will be the means of saving expenditures for food that would otherwise be made out of the money crop; and the health and general well-being of the family would be thus promoted.

Utilization of Cut-over Timber Lands

Another important problem is the utilization of the cut-over timber lands in East Texas. The utilization of this land for grazing during the growth of a crop of timber is an important resource which should be given consideration. Not only is the question of utilizing the land for grazing important, but it is also important to develop such information as will enable the proper balancing of the farm enterprise in the section, to the end that the cultivated and forested areas may be utilized to the best advantage.

These and many other problems which could be mentioned are very important for the development of the agricultural resources of Texas and consequently the development of the wealth of Texas.

ORGANIZATION AND WORK

The main divisions and scientific laboratories and the experiment substations and field laboratories located in several regions of the State are as follows:

Divisions	Substations
Administration	No. 1. Beeville, Bee County
Veterinary Science	No. 2. Troup, Smith County
Chemistry	No. 3. Angleton, Brazoria County
Horticulture	No. 4. Beaumont, Jefferson County
Range Animal Husbandry	No. 5. Temple, Bell County
Entomology	No. 6. Denton, Denton County
Agronomy	No. 7. Spur, Dickens County
Plant Pathology and Physiology	No. 8. Lubbock, Lubbock County
Farm and Ranch Economics	No. 9. Balmorhea, Reeves County
Soil Survey	No. 10. College Station, Brazos County
Botany	No. 11. Nacogdoches, Nacogdoches County
Publications	No. 12. Chillicothe, Hardeman County
Swine Husbandry	No. 14. Sonora, Sutton-Edwards Counties
Dairy Husbandry	No. 15. Weslaco, Hidalgo County
Poultry Husbandry	No. 16. Iowa Park, Wichita County
Main Station Farm	
Feed Control Service	

Research Field Laboratories

- State Apicultural Research Laboratory, San Antonio, Bexar County
- Research Queen Yard, San Antonio
- Research Bee Outyard, Dilley, Frio County
- Research Bee Outyard, Roxton, Lamar County
- Research Bee Outyard, Seguin, Guadalupe County
- Loin Disease Research Field Laboratory, Bammel, Harris County

For the State fiscal year ended August 31, 1926, the inventories of the Texas Station totaled \$960,132.73, exclusive of the property of the College now being used for Station purposes. This property, which consists of land at College Station, two brick buildings on the campus, all carried on the College inventory and not repeated in the Station inventory, is valued at \$139,449.69. The total value of all property

being used at this time for the purposes of the Agricultural Experiment Station System is \$1,099,582.42.

Veterinary Science

Projects

1. Loin Disease of Cattle; Adams fund; H. Schmidt, leader.
2. Swellhead of Sheep and Goats; Adams fund; H. Schmidt, leader.
3. Swamp Fever of Horses and Mules; Hatch and State funds; H. Schmidt, leader.
4. Infectious Bovine Abortion Studies; Hatch and State funds; H. Schmidt, leader.

Loin Disease of Cattle

The loin-disease project is conducted mainly along two lines, namely: (1) that phase dealing with the bacteriological study and the artificial production of loin disease in cattle, the major part of which is carried on at the main laboratory at College Station; and (2) that phase of the study pertaining to the control of the disease and the collection of data dealing with the probable cause, conducted chiefly at the Loin Disease Field Laboratory, located near Bammel, Harris County, Texas.

The studies carried on at the main laboratory at College Station, having as their objective the finding of the specific organism or organisms, if any, responsible for the toxin, have included the collection of bones and other carcass material from the Loin Disease Field Laboratory, to be dried, ground, and fed to cattle. Varying amounts were consumed by different animals on test. One of the animals thus fed for a period of thirty days developed what was considered a light case of loin disease, and a case very similar to, if not identical with light cases previously observed on the grounds of the Loin Disease Field Laboratory. Cultures from samples of ground bone were made, and nine animals were drenched with the liquid portion of the culture without any developments or symptoms of loin disease. Samples of surface soil were collected from the pastures at the Loin Disease Field Laboratory where carcasses had been allowed to putrify, cultures were made, and after incubation the liquid portion decanted and steers drenched with it. No symptoms of loin disease could be observed in any of the animals thus drenched.

The Loin Disease Field Laboratory, at Bammel, comprising 1400.9 acres and consisting of five different pastures, has been used chiefly for the conduct of feeding tests with different mixtures of bone meal and salt, and bone meal, salt, and acid phosphate (dibasic), with animals of different ages. Ninety-one cows, 2 bulls, 12 yearling heifers, and 40 calves were used, to which were added in May, 27 cows purchased from funds provided by the commissioners court of Harris County, and five cows purchased from veterinary sales fund. Scales for weighing the animals were installed on the grounds of the Loin Disease Field Laboratory to more effectively study the effects of bone-

meal consumption. The data collected up to May 1, 1926, have been published as Texas Station Bulletin No. 344, "Feeding Bone Meal to Range Cattle on the Coastal Plains of Texas." The results show:

(1) That the feeding of bone meal increased the gain in weight during the favorable season.

(2) That cows fed on bone meal rear better calves.

(3) That the feeding of bone meal effectually prevents "creeps."

(4) That the feeding of bone meal reduces the losses from diseases other than of an infectious character.

(5) That finely ground rock phosphate cannot be used to take the place of bone meal.

(6) That the feeding of bone meal may cause the animals to forego bone-chewing, although they may occasionally resume the habit during the summer. Bone-chewing under these conditions, however, was in nowise so frequent as before the animals had received bone meal. Three animals that had been receiving bone meal were observed to again resume bone-chewing, and contracted loin disease, dying soon thereafter.

(7) Data have been collected showing that calves approximately one year old occasionally may chew a bone. The general observation is that animals do not contract loin disease at a younger age than 18 months.

(8) Seven cases of loin disease have occurred on the Loin Disease Field Laboratory grounds. Two of these cases had been on bone meal and salt mixture for approximately a year, and both were observed to have resumed bone-chewing. Another case had been on bone meal, salt, and rock phosphate without results as to her bone-chewing tendencies. Still another cow on bone meal was observed to chew bones and she subsequently contracted loin disease and died of it. Case No. 119, control animal without bone meal, was a frequent bone-chewer and died of loin disease. The two remaining cases were both known to be bone-chewers, although they received bone meal. Thus, in all seven cases, the animals contracting the disease were known to be bone-chewers, even though all but one received bone meal. It is very evident, therefore, that bone meal is not a sure preventive of bone-chewing in all cases.

(9) A number of cases have been observed at the Loin Disease Field Laboratory which had not previously been recognized as loin disease but which are now believed to have been light cases of loin disease, and it seems fairly certain that there is a variation in the virulence of the disease.

(10) A close study of the vegetation on the grounds of the Loin Disease Field Laboratory was made, especially as regards poisonous plants. Only one species of poisonous weed was found, *Asclepias verticellata*, and the known symptoms of poisoning due to this plant did not coincide with the symptoms of loin disease.

Swellhead of Sheep and Goats

The work on this project has been transferred to Substation No. 14, Sonora, where conditions are better than at College Station for the study of the problem. This project, however, may be classed as an intermittent one as conditions are not always favorable for study of the problem, owing to lack of material in certain seasons. During the year, material has not been available and no progress has been made on this study. Owing to the nature of the project, it was removed from the Adams fund on June 22, 1926, and is being revised and rewritten as a State-fund project and continued at Sonora because of its importance to the sheep and goat industry of that region.

Swamp Fever of Horses and Mules

A small allotment of State funds provided some experiment animals for this study during the year. Certain drugs, including formin, formaldehyde, tartar emetic, mercurochrome 220, Bayer 205 (Naganol), were used in a search for some curative method, but without satisfactory results. Seven experiments were carried out, using the drugs heretofore mentioned, in a search for a curative method, with the following results: none of the drugs were considered as having any influence upon the course of swamp fever, and three grams of tartar emetic in 100 c.c. of distilled water, given intravenously, caused death of the animal.

Serum from one animal which had gone through several severe reactions a number of years ago, and which had apparently made complete recovery and become immune, was also tried. The blood from the mule was found to be no longer infectious and he withstood extraordinary doses of virus of swamp fever without reaction. Thinking that serum from this animal should have some immunizing values, inoculations of his blood into a horse fevering were made, but in spite of these injections—two in number—the horse died, indicating the lack of curative values in the blood from this animal. Very shortly afterward, this supposedly immune animal contracted swamp fever and died, presumably from previous heavy inoculations. The point here is that in connection with this problem there is either an unusual resistance in certain cases, or some condition which held this case in abeyance causing a very unusual behavior.

Infectious Bovine Abortion Studies

Project No. 194, "Infectious Bovine Abortion Studies," was approved April 6, 1925, but no report was made last year because the work had not yet progressed far enough.

Between April 25, 1925, and September 11, 1926, all cows of breeding age in the Feeding and Breeding Station dairy herd were vaccinated for bovine infectious abortion. Forty cubic centimeters of a 30-day old live bouillon culture were injected at eight different points on both sides of the neck of the animals, making four injections on

each side. By using this method we did away with the abscess reported to frequently form when large quantities of a live culture are injected at one point. The method may also have otherwise contributed favorably to our results.

The dairy herd at the Feeding and Breeding Station is ideal for this study because complete records of all abortions in the herd that have occurred in the past are available, together with the breeding efficiency of the herd. From the annual reports of the activities of the Feeding and Breeding Station the following data have been compiled concerning these two points: (1) the first abortion occurred in that herd in December, 1915, and is listed for the year 1916; and (2) ten live calves were born in 1915. Further progress of the disease in that herd is given in the following table:

TABLE 1
Status of Abortion in Feeding and Breeding Dairy Herd

Year	Number of Abortions	Number of Live Calves	Percentage Abortions
1916-17.....	10	10	50
1917-18.....	9	14	39.13
1918-19.....	4	31	11.4
1919-20.....	8	21	27.6
1920-21.....	7	23	25.33
1921-22.....	8	26	23.53
1922-23.....	9	38	19.15
1923-24.....	12	32	27
1924-25.....	10	52	16.13

(NOTE: 1916-17, and so forth, means from 8-31-16 to 9-1-17, with the exception of the last year, which began on 9-1-24 and ended on December 31, 1925. All abortions occurring in this latter year occurred in animals which had not yet been vaccinated.)

Results obtained in the same herd since vaccination began on April 3, 1925, are as follows:

Number of abortions in cows since vaccination for abortion between April 3, 1925, and August 31, 1926.....	1
Number of normal calvings since vaccination.....	19
Number of services required to get 12 of these cows with calf before vaccination	19
Number of services to get the same 12 cows with calf after vaccination	16
Number of services required to get 11 heifers with calf before vaccination	13
Number of services required to get seven heifers with calf after vaccination	10

Doubtless it is still too soon to form a definite opinion about the value of the vaccination, for up to the present only 20 cows that have been vaccinated have calved. Although upon the basis of these figures the results appear very promising, yet they may take a change for the worse when more come due. There is no concealing the fact, however, that the results as they stand today have far exceeded our expectations.

Unfortunately, the figures available at this time concerning the

breeding efficiency are still rather meager, being limited to a total of 12 cows that have calved more than once. The results in these indicate, however, that the vaccination with live cultures, although to be condemned from a medical standpoint, has in no way reduced the breeding efficiency of this herd. Concerning the abortion in the one cow since vaccination, it should be noted that this cow had aborted her three previous calves, which would indicate that she is a rather obstinate aborter.

Chemistry

Projects

1. Nutritive Values of Feeds; Adams fund; G. S. Fraps, leader.
2. Soils Studies; Adams fund; G. S. Fraps, leader.
3. Plants; Their Composition and Properties; Hatch and local funds; G. S. Fraps, leader.
4. Composition and Properties of Soils; Hatch and local funds; G. S. Fraps, leader.
5. Human Food; Its Composition, Properties, Utilization, and Preservation; Hatch and local funds; G. S. Fraps, leader.
6. Feed Analyses and Investigations; Feed Control and local funds; G. S. Fraps, leader.
7. The Value of Sulphur to Texas Soils and Crops; cooperative study; funds provided by Freeport Sulphur Company; G. S. Fraps, leader.
8. Pecan Soils in Texas; local and State funds; G. S. Fraps and W. T. Carter, leaders.
9. Variations in Vitamin Content of Texas Foods; Purnell fund; G. S. Fraps, leader.

Soils

Considerable work has been done on potash of Texas soils. A bulletin is being prepared which will probably be completed in a short time. It is expected to work more upon phosphoric acid and nitrogen than upon potash during the coming year.

Chemical analyses and pot experiments have been made upon a number of samples of typical soils. A bulletin (No. 337) is being published discussing the soils of Eastland, El Paso, Lubbock, and San Saba Counties. Another bulletin on four other counties is in preparation, and it is hoped to have it completed within a short time.

Digestion Experiments

Digestion experiments with sheep and chickens have been continued and a few made on rats. Thirteen experiments were made on chickens, ten on sheep, and six on rats. The study of the sugars, starches, pentosans, and other constituents of feed was continued.

Assistance was given in preparing a bulletin on feeding cottonseed meal. This was a joint bulletin in which the Experiment Station, the Extension Service, and the School of Agriculture cooperated to produce

a bulletin representing our present attitude toward feeding cotton-seed products (Bulletin No. 341). The information was prepared at the request of the Texas Cotton Seed Crushers Association.

Sulphur

The study of sulphur as a fertilizer was continued with the funds provided by the Freeport Sulphur Company. One man is giving his entire time to this work. The work done thus far indicates that there is little prospect at the present time for the use of sulphur or sulphur compounds as fertilizers in Texas. The scientific phases of this problem are interesting. The practical possibilities seem so slight that it is considered best to discontinue the intensive study of sulphur as a fertilizer at the end of December. The study of some of the phases of the problem will be continued. The results secured will be published as soon as possible after the last of December.

Feed Analyses

About two thousand samples have been examined for the Feed Control Service. The examination includes not only the complete feed analysis of each sample but also a physical examination and a microscopic examination. In addition, this Division is called upon for expert service concerning definitions and standards to be adopted. It is exceedingly important that the names under which the feeds are registered should correctly represent the goods sold, and that the guarantees should correspond. Otherwise, the Feed Control would be in the position of legalizing misleading statements. A national definition for wheat gray shorts satisfactory to all parties concerned was adopted in Washington last fall, and this Experiment Station took considerable part in assisting in the adoption of a proper definition and standard.

Fertilizer Control

The Chief of the Division of Chemistry of the Agricultural Experiment Station is also State Chemist in charge of the fertilizer control. The usual fertilizer bulletin has been prepared.

An exceedingly important step in the fertilizer industry was made in 1925, in that the number of fertilizers offered for sale by the manufacturers was reduced to about twenty-one. This action simplifies the matter for the manufacturer and the farmer, aids in the more intelligent use of fertilizers, and also aids in reducing the cost of plant food to the farmer. Texas is the first State to succeed in following the advice of Secretary Hoover in reducing the number of fertilizer mixtures placed on the market. The first steps toward this action were taken when the standard formulas were adopted in 1923.

Miscellaneous

A number of miscellaneous samples have been analyzed, including soils, irrigation waters, sugar beets, boll weevils, and so forth. Sam-

ples of feeds, grass, soils, and other materials were analyzed for other divisions of the Experiment Station. The State Chemist has also acted as referee on fertilizers and as a member of the Committee on Definitions of Terms and Interpretations of Results on Fertilizers for the Association of Official Chemists.

The Division continues to receive requests for analyses of various kinds for private purposes. The policy pursued is to furnish all the information possible, but to make no analyses unless they will be of public benefit. If this Division undertook to accept private work, it would be unable to complete its regular work and carry on its investigations.

Horticulture

Projects

1. Figs; State funds; W. B. Lanham, leader.
2. Pecans; State funds; W. B. Lanham, leader.
3. The Effect of Certain Cultural Methods upon the Production of Early Tomatoes; State funds; W. B. Lanham and W. H. Friend, leaders.
4. The Effect of Certain Cultural Methods on the Yield of Marketable Onions; State funds; W. B. Lanham and W. H. Friend, leaders.
5. Tomato Variety Tests; State funds; W. B. Lanham and W. H. Friend, leaders.
6. Pepper Investigations; State funds; W. B. Lanham and W. H. Friend, leaders.
7. A Cultural and Varietal Test of Celery; State funds; W. B. Lanham and W. H. Friend, leaders.
8. Cantaloupe Culture; State funds; W. B. Lanham and W. H. Friend, leaders.
9. A Study of Miscellaneous Vegetables; State funds; W. B. Lanham and W. H. Friend, leaders.
10. Strawberry Production; State funds; W. B. Lanham and W. H. Friend, leaders.
11. Pomelo (Grapefruit) Production; State funds; W. B. Lanham, leader, assisted by W. H. Friend.
12. Peach Production; State funds; W. S. Hotchkiss, leader, assisted by W. B. Lanham.
13. Introduction of Horticultural Plants; State funds; W. B. Lanham, leader.

Figs

The objects of this work are to study the fertilizer needs of figs, the control of fig rust, and the growing and harvesting of the fruit in such a way that a product of high quality can be marketed. The fertilizer work done thus far at Beaumont and Angleton appears to be more or less contradictory in that the largest yield obtained was from the application of a complete fertilizer and the second best yield from the application of lime alone. No results have been obtained in-

dicating the need of potash and very little indication of the need of nitrogen; whereas, in every case where phosphorus has been used, either alone or in combinations, the yield has been increased. The results obtained must be considered preliminary.

In the control of fig rust, spraying with 5-5-50 Bordeaux mixture every 30 days as soon as the disease appears gave very promising results. Spraying with the same mixture at 15-day intervals gave no better results. Spraying with 10-10-50 gave no better results than 5-5-50.

Pecans

The work with pecans is concerned with factors affecting production, such as propagation, root stock, and varieties. The work thus far is in a preliminary stage, but much material has been accumulated which will offer facilities for active prosecution of this work in the immediate future. The problem is an important one to Texas and one requiring an aggressive program. The nature of the problem is necessarily one that will require considerable time for mature data.

Tomatoes

The work with tomatoes has been concerned very largely with the effect of potash fertilizers on the carrying quality of tomatoes. Tomatoes grown at Troup, the Lower Rio Grande Valley Station, and at the Wichita Falls Station, with and without potash fertilizers, have been shipped to College Station and together with local-grown tomatoes carried through laboratory tests to determine their carrying qualities. The work thus far indicates that potash has no effect on the time of ripening or on the carrying qualities. These results are being tabulated and will be digested and presented as a preliminary publication at an early date.

Pomelos (Grapefruit)

This project involves the study of the principal phases of pomelo production, including varieties, soil management, pruning, and the horticultural phases of insect control. A large number of new varieties have been planted, and the soil management phases particularly are being vigorously pushed at this time. The results to date are not sufficiently mature for comment.

Peach Production

The work with peach production is concerned chiefly with varieties, pruning, fertilizers, and insect control. The variety work is being carried at the Main Station, at Balmorhea, Wichita Falls Station, and at Troup, and at all these places pruning work is being carried along with these varieties. The pruning problem seems to be an important one to the life of the tree and to its regularity of fruiting. The work will necessarily require several years. Fertilizer work with peaches is being

carried at the Troup Station, and this year was the first year the orchard has fruited sufficiently to give comparative results since the fertilizer work was started. A disastrous hail storm, however, completely destroyed the crop and greatly injured the trees, so that results are not available at this time.

Introduction of Horticultural Plants

The objects of this work are to test out horticultural plants obtainable from any source for adaptability to conditions in the various agricultural regions in Texas and to find the best method of reproducing superior introductions for general use. Two very promising ornamentals, the Athel (*Tamarix articulata*) and the Chinese elm (*Ulmus pumila*) have been found to be pretty generally adapted to the whole State. The Chinese elm seems particularly well adapted to the northern and northwestern parts of the State and the Athel to the coastal plains section. It seems important to find a section where seed production is dependable, as the production of seed is one of the dependable means of rapid propagation of the Chinese elm.

Jujubes have fruited heavily during this season, continuing to be a consistent producer under our varied conditions in Texas. Certain varieties seem to be very superior to others in quality of fruit, and it is believed that this plant, especially if the better varieties are used, can and should be grown on individual farms as a source of fresh fruit and for preserving. The certainty with which the jujube produces crops makes it an important fruit, available at times when fresh fruits on the farm are ordinarily not available. Circular No. 41 has been issued, discussing the merits of this plant under Texas conditions.

The **Methley plum**, the **Crosby nectarine**, and the **Quetter nectarine** continue to show very promising results in the orchard at the Main Station and a limited amount of propagating material from these varieties has been furnished to interested nurserymen. A collection of deciduous fruits and nuts have been planted at Substation No. 9, Balmorhea, with a view of determining their suitability to the particular conditions there.

Range Animal Husbandry

Projects

1. Sheep Breeding Investigations, Study of the Inheritance of the Fur Qualities of Karakul Sheep; State and Federal funds; J. L. Lush, leader.
2. A Determination of the Relation of Skin Folds to Weight of Fleece on Rambouillet Sheep; State and local funds; J. M. Jones, J. L. Lush, and E. W. Thomas, leaders.
3. A Study of Type and Inheritance in Angora Goats; State and local funds; J. M. Jones, J. L. Lush, and E. W. Thomas, leaders.
4. Inheritance in Brahman and Hereford Cattle; Adams, State and local funds; J. L. Lush, leader.

5. Inheritance of the Ridgeling Characteristic in Goats; State and local funds; J. L. Lush and E. W. Thomas, leaders.

6. Fattening Steers on Sumac Silage, Sumac Fodder, and Cottonseed Hull Rations, Supplemented with Ground Milo Heads and Cottonseed Meal; in cooperation with Bureaus of Animal Industry and Plant Industry; E. W. Sheets (B. A. I.), F. D. Keating (B. P. I.) and J. M. Jones for Station.

7. Feeding and Killing Qualities of Brahman, Shorthorn, Hereford, Brahman-Shorthorn, and Brahman-Hereford Calves; in cooperation with Bureau of Animal Industry, U. S. Department of Agriculture; W. H. Black, for Bureau of Animal Industry, and J. L. Lush, for Station.

8. The Relation of Body Shape to Rate of Gain, to Dressing Percentage, and to Value of the Dressed Meat in Beef Cattle; Purnell funds; J. L. Lush, leader.

9. Insects and Parasites Affecting Live Stock; in cooperation with Bureau of Entomology, U. S. Department of Agriculture; leaders: F. C. Bishopp and O. G. Babcock, for Bureau of Entomology, and J. M. Jones and D. H. Bennett, for Station.

10. A Study of the Adaptation of the Corriedale Sheep to Southwest Texas Conditions; in cooperation with Bureau of Animal Industry, U. S. Department of Agriculture; J. M. Jones and E. W. Thomas, leaders.

11. An Economic Study of Shearing Sheep Once vs. Twice a Year; State and local funds; J. M. Jones, leader.

12. Determining Grades and Shrinkages of Representative Samples of Texas Wool and Mohair; State and local funds; J. M. Jones and Frank Grayson, leaders.

13. Relation of Age of Animal to Fineness of Wool and Mohair Fiber; Purnell funds; J. M. Jones and J. L. Lush, leaders.

Sheep Breeding Investigations with Karakul Sheep

All detailed data on this project, except the descriptions of the skins are taken at Substation No. 7, Spur. The detailed descriptions of the skins are made at the Main Station, College Station. The results have rather clearly shown that Karakul sheep are not the most suitable breed for farm flocks in the region about Spur, and indeed, if they are adapted to any region whatever in this country, it is probably some desert region where the climatic conditions are too harsh for Rambouillet or Merino sheep to thrive. Future breeding work on the Station flock will proceed along the line of doing a small amount of inbreeding to see whether great uniformity in the pelts can be produced in this flock. The lack of uniformity in the pelts is the most serious obstacle to a satisfactory commercial outlet for pelts produced in small numbers.

Relation of Skin Folds to Weight of Fleece in Rambouillet Sheep

This study has not progressed far enough to enable us to reach definite conclusions regarding the inheritance of skin folds. Considerable difficulty has been experienced in finding foundation stock for the desired type. Something definite must, or at least should be, known of the parentage of the different individuals being used in this study. The B and C type Rambouillet ewe flocks that are being used in this study are now headed by two very desirable B and C type rams. A satisfactory percentage of lambs by these rams was secured during the past lambing season. As a general rule, it has been found in practice that the fleeces of B type Rambouillets have a tendency to be of shorter length than fleeces grown on C type individuals.

There is a general belief that C type rams, which, as a general rule, possess a more open fleece than B type individuals, will, when mated to C type ewes, produce offspring possessing a tendency to produce a lighter weight of fleece of less density than C type parents. In brief, an attempt is being made to ascertain whether fleece qualities and weight are inherited in any definite fashion. There are at present about 127 mature breeding ewes in the registered Rambouillet flock. Wool grading and scouring tests are being continued on the stud rams and the ewes, and it is interesting to note that individual scouring tests made on the members of the ewe flock during the past two years have shown that the C type sheep produce more scoured or clean pounds of wool than do the B type individuals, which produce heavier unscoured fleeces than the C type individuals on the general average. Diameter measurements are being made annually on three representative samples from shoulder, thigh, and side of the respective animals under observation. One hundred fibers from the shoulder, side, and thigh, respectively, are being measured by means of the micrometer caliper, which is graduated to one ten-thousandth of an inch.

Type and Inheritance in Angora Goats

This study is being made with the view of determining something more definite regarding type and inheritance in Angora goats. There is no official standard of perfection for the Angora goat: there is, therefore, a great diversity of opinion regarding type. There is also a great difference of opinion regarding type of locks. The manufacturers, judging from the information we have been able to get from them, prefer the ringlet type of lock. All of these factors are being considered in this study. Some twenty body measurements are being made on the goats at regular yearly intervals, with the view of determining something more definite about the development. Shoulder, side, and thigh samples of mohair are being measured through the use of the micrometer caliper.

There is also a great deal of difference of opinion among breeders as to whether mohair fleeces should possess a high shrinkage or whether it should be low. The mohair fleeces from the station's flock of An-

gora goats shrink around 12 to 14 per cent, while the average of the State is perhaps around 15 or 18 per cent. Some Angora goats produce much higher shrinking fleeces, the shrinkage being in certain isolated instances at least 25 per cent or above. There is a general tendency for the heavier-shrinking mohair fleeces to be of lower quality and coarser than the lighter-shrinking type of mohair. The data collected in connection with this study have as yet not been systematically analyzed; a sufficient amount of material, however, has now been accumulated to warrant a thorough analysis, with the view of issuing a progress report covering this study.

Inheritance in Brahman and Hereford Cattle

The objects of the study of inheritance in Brahman and Hereford cattle are to determine the methods of inheritance of size, body-shape, earliness of maturity, hardiness, fattening ability, and dressing percentage, with the general purpose of finding out what place, if any, Brahman blood should have in the program of practical beef-production in Texas. No general report on this project has as yet been prepared for printing as the project is still in progress. The fourth and fifth crops of cross-bred steers dropped at Substation No. 14, Sonora, were fattened out at Substation No. 1, Spur, and detailed slaughter and meat data were secured on them at Fort Worth. The first and second crops of back-cross (to the Hereford) steers were included in this feeding. In general, the back-cross steers were intermediate to the first-cross steers and to the Herefords in their feeding and killing qualities, although heavier than either. The results of this year's feeding work confirm those of the two preceding years. Steers carrying Brahman blood do not make such large gains in live weight while in the feedlot as the Herefords do; part of the Hereford extra gain, however, is paunch and intestine weight. The Brahman crosses dress out a higher percentage of meat, but the shape of their carcass is less desirable to the average butcher. The wildness of the Brahman crosses make them more susceptible to bruises in shipping. The sixth crop of first-cross calves and the third crop of back-cross calves were dropped at Substation No. 14, Sonora, this year, and will probably be fed out as calves during the coming year. They seem to correspond very closely with the calves of the last two years. The wild disposition of the Brahman crosses is a serious defect on ranches where they are handled very much, but is not so serious a matter on large commercial ranches where they are not rounded up more than a few times each year. The Brahman crosses show up to best advantage during the summer. Their economic advantages seem to lie almost entirely in their hardihood, their ability to thrive during hot weather, their ability to move about more quickly and easily without much effort, and their high dressing percentage. Their greatest disadvantages are their wild disposition, the

undesirable conformation of their carcasses, and probably their susceptibility to cold weather.

Inheritance of the Ridgeling Characteristic in Angora Goats

The object of this study is to discover how the ridgeling characteristic is inherited in goats and how best to eradicate it from a flock. It has been conclusively demonstrated this year that this characteristic really is inherited. One ridgeling male this year sired ten ridgeling and only seventeen normal males; another sired eight ridgeling and only ten normal males. The manner of inheritance of this characteristic, however, is not yet explained. The only indication that its inheritance is at all simple is that the percentage of ridgelings produced in the experimental flock made such a sudden sharp increase when breeding was begun from does which also had ridgeling blood in their pedigrees. Present procedure is directed toward building up a strain of goats which will approach as nearly as possible to producing 100 per cent of ridgelings among their male kids. This is being done by line-breeding to two different ridgelings. A son of each is being used for the coming year and other sons are being held in reserve. Cytological examination of several cryptorchid testes has shown that all were in such a condition that they could not possibly have produced living spermatozoa. From this and other recently published discoveries, as well as from the negative results of attempts two and three years ago to breed from ridgelings from which the normal testicle had been removed, we are certain that ridgeling goats can be made sterile by having their one descended testicle removed, without its being necessary to remove the cryptorchid one. However, unless both testicles are removed, the ridgeling goat retains his sexual instincts and is a nuisance in the flock. A preliminary, semi-popular, report of these facts has been published in the Sheep and Goat Raisers Magazine, but no detailed presentation of data is expected to be made until the manner of inheritance of this defect has been more completely solved.

Roughages for Fattening Steers

The project on fattening steers on sumac silage, sumac fodder and cottonseed hull rations, supplemented with ground milo heads and cottonseed meal involves a series of three feeding trials with steer calves, the object being to determine the relative values of sumac silage, sumac fodder and cottonseed hulls as a source of roughage in the fattening ration. The third feeding trial (lasting 203 days) was concluded at the United States Field Station, Big Spring, Texas, June 8, 1926. The results of this test show that the cost of feed per 100 pounds of gain for the lots receiving the silage (lot 1), and sumac fodder, (lot 3), to be approximately the same. Each of these two lots made practically identical gains as was the case in the 1924-25 test. The lot receiving cottonseed hulls (lot 2), made a considerably smaller gain at a cost of approximately \$1.00 per hundred pounds above that of

lots 1 and 3, receiving silage and fodder, respectively. These cattle were graded or scored individually at the time of being placed on feed and again at the termination of the feeding experiment, the objects of these observations being to determine something more definite as to whether feeder steers grading "choice," "good," or "common" as feeders remain within their respective grade until they are ready for slaughter. Representative rib cuts of animals from the three lots were shipped to Washington, D. C., to be used in the determination of marbling quality and fat. The results of the three feeding experiments are being summarized and will be ready for publication at an early date.

Feeding and Killing Qualities of Brahman, Shorthorn, Hereford, Brahman-Shorthorn, and Brahman-Hereford Calves

This is a cooperative project with the United States Department of Agriculture and with the King Ranch. The past year was the second year of the experiment, and during the year nearly one hundred head of calves were fed out at Kingsville, and detailed records were secured of the feedlot data and of all slaughter data which, from the previous year's work, seemed likely to yield much valuable information. During this year a grading committee appointed by those in charge of the cooperative projects on the study of the factors which influence the quality and palatability of meat, graded the feeder steers, and finished steers, and dressed carcasses. The data from this grading have yet to be analyzed. In general, the results of the second year's work tend to substantiate the first, which has already been published in mimeograph form. The final shipment of finished steers this year was made to Kansas City, where contact was had with the opinions of a totally different group of commercial-meat experts.

The Relation of Body Shape to Rate of Gain, to Dressing Per Cent and to Value of the Dressed Meat in Beef Cattle

The objects of this project are: (1) to determine the relation between shape of steers when they are placed on feed, and the subsequent gains which they make in the feedlot; (2) to determine the relation between shape of steers when they are placed on feed, and their dressing per cent at the end of the feeding period; and (3) to determine the relation between the shape of steers when they are placed on feed, and the commercial value of their dressed meat as measured by its appraised selling price.

Records bearing on this problem have been accumulated for eleven lots of steers fed out at Substation No. 7, Spur, during the last four years, and analysis of these records by statistical methods has proceeded rapidly during the year, but no publication of the results has yet been prepared.

Insects and Parasites Affecting Livestock

This is a cooperative project with the United States Department of Agriculture (Project No. 118), and is divided into three parts, as follows:

Subproject No. 118-A, The Screw Worm and Wool Maggot.

Subproject No. 118-B, The Goat Louse.

Subproject No. 118-C, A Study of the Sheep Scab, the Sheep Scab Mite, Its Life History and Eradication.

Work was begun on Subprojects No. 118-A and 118-B in 1920. No work was done in connection with Subproject No. 118-A during the past fiscal year. Considerable progress was made in the goat-lice studies, and it is believed that the United States Department of Agriculture and the Texas Station, cooperating, will have some definite information to hand to the goat breeders of Texas by the first of next year covering the control and possibly the eradication of lice. Subproject No. 118-C, conducted at Substation No. 14, Sonora, has shown considerable progress during the year. It has been found that the sheep scab does not live off the host more than several weeks. It has, furthermore, been found that dipping tests have revealed that some of the standard dips, at the proper strength, have been very effective in the destruction of the scab mite. This project was initiated by this Division and is being carried out by an Entomologist from the Bureau of Entomology, U. S. Department of Agriculture, and a Veterinarian of this Station, both assigned to the Sonora Substation.

A Study of the Adaptation of the Corriedale Sheep to Southwest Texas Conditions

This is a cooperative project with the Bureau of Animal Industry, United States Department of Agriculture. It was begun in 1920 with only eight head of registered Corriedale ewes and a registered Corriedale ram. Progress has been disappointingly slow on account of the small number. A number of records, including grease and scoured fleece weight, birth weights, weaning weights, breeding flock weights, at designated periods, including notes on the thriftiness or hardiness, are being taken. Owing to the peculiar climatic conditions of Western Texas, that section appears to be better suited to the production of fine-wool breeds of sheep than to the breeds commonly designated as mutton breeds. During the past year, the aged Corriedale ewes produced 4.02 pounds of clean or scoured wool as compared with 3.55 pounds of scoured wool produced by the registered Rambouillet ewes. The aged Corriedale ewes averaged 98 pounds in weight after shearing in 1926, while the aged registered Rambouillet ewes averaged 104 pounds. The average birth weight of 20 Corriedale ram lambs dropped in 1926 was 9.3 pounds, as compared with an average of 10 pounds for 80 Rambouillet lambs. The lambing percentage of the Corriedale flock in 1926 was 83 per cent, as compared with 61 per cent for the registered Rambouillet flock. The shrinkage of the Corriedales' wool was 44 per cent, as compared

with 57 per cent for the registered Rambouillet flock in the spring of 1926.

Shearing Sheep Once versus Twice a Year

The study of shearing sheep once versus twice a year has been under way since 1920. A summary of the shearing records shows that there is an advantage of 0.62 pounds shown in favor of shearing twice a year. The 1925-26 shearing records show a greater difference in favor of shearing twice a year than any of the previous tests have indicated. The reversal method was used during the first five tests; it was decided in 1925-26, however, not to follow this former practice, but instead to shear the original 12-month fleece group at 12-month intervals, and to shear the 6-month group at 6-month intervals. In the 1925-26 shearing test, the group of aged ewes sheared twice during the year yielded one pound more (grease-weight fleeces) than did the corresponding group sheared once a year. In the yearling group of ewes those sheared twice a year produced 0.75 pound more grease-weight wool than the group sheared at 12-month intervals. This difference is not significant since on the basis of the current market quotation for Texas wools, 12-month or staple wool is worth from five to 10 cents more per grease pound than the 6-month fleeces.

Determining Grades and Shrinkages of Texas Wool and Mohair

This study is being made in cooperation with wool and mohair growers patronizing the wool and mohair scouring plant. Also grading and scouring data are being secured from the wool and mohair fleeces originating at the Ranch Experiment Station, Sonora. One of the primary objects of the study is to accumulate, if possible, a sufficient amount of data which will give the wool and mohair growers of Texas a more accurate knowledge of the grades and shrinkages of the wool and mohair that they are producing. Since the establishment of the scouring plant at College Station, 700 separate scouring tests have been made for the wool and mohair producers of Texas, while several samples have been graded and scoured for out-of-state producers. Aside from the service that has been rendered to the wool and mohair producers of Texas, approximately 4,000 individual tests have been made on wool and mohair fleeces originating at the Ranch Experiment Station, near Sonora.

Relation of Age of Animal to Fineness of Wool and Mohair Fiber

In this study, having for its object the determination of the influence of age of animal upon the fineness of wool and mohair fibers, 100 fibers are being measured annually from shoulder, side, and thigh samples respectively, through the use of the micrometer caliper. This study has been under way only a short time. A large amount of data have been accumulated already, but the project will need several years for completion. No publication of results has yet been prepared.

ENTOMOLOGY

Projects

1. An Aphid Study to Determine the Factors which Influence the Formation of Wings; Adams fund; H. J. Reinhard, leader.
2. A Study of the Ingestion of Poisons by the Cotton Boll Weevil; Adams fund; F. L. Thomas, leader.
3. Life History of the Cotton Hopper and Its Control; State funds; F. L. Thomas and H. J. Reinhard, leaders.
4. Miscellaneous Insect Investigations; Control of Ants on Citrus Fruits; State funds; F. L. Thomas and W. H. Friend, leaders.
5. Control of Scale Insects on Citrus Fruits; State funds; F. L. Thomas, W. H. Friend, and E. Hobbs, leaders.
6. Boll Weevil Control by Use of Airplanes; State funds; F. L. Thomas, leader.
7. Sulphur and Sulphur Compounds as Fungicides and Insecticides; Sulphur funds; F. L. Thomas and J. J. Taubenhaus, leaders.
8. Foulbrood Inspection; State funds; S. E. McGregor, leader.
9. Beekeeping Investigations; State funds; H. B. Parks, leader.

In general the season of 1926 may be classified as an insect year. The cotton crop has suffered from attacks of cutworms, grasshoppers in some sections, cotton flea hoppers, boll weevils, cotton boll worms, and leaf worms. There have been outbreaks of other insects upon other crops. It has been difficult for the small personnel of the Division of Entomology to meet the demands created by these emergencies and at the same time to carry on uninterrupted investigations of the regular projects.

Aphid Studies

During the past year 54 complete generations of *Aphis gossypii* have been reared, including a total of 748 aphids. Of this number, 3 per cent were winged forms. They occurred in only 6 of the 54 generations and in each instance crowding had taken place. Isolations were made from 8 different generations and the individuals developing in each isolation were allowed to become crowded. In every case winged forms appeared whether the temperature was high or low, as long as it was sufficiently high to permit reproduction. Winged or wingless forms can be produced at will by permitting or preventing a crowded condition to occur. In 51 generations the progeny were not permitted to become crowded and all were wingless; in 3 generations crowding occurred and winged forms appeared. Twenty-four isolations were made of groups of aphids, their progeny allowed to become crowded, and in every instance winged forms appeared.

Ingestion of Poison by the Cotton Boll Weevil

Following up the work reported last year, field applications of calcium arsenate dust were made to cotton in the morning when a heavy dew was present. These applications were made with a two-row horse-

drawn traction duster, at the rate of 10 pounds per acre. Squares, buds and bracts were carefully cut from the upper portions of about 200 plants the same day that the calcium arsenate was applied. Each sample of squares, buds and bracts was placed in separate jars. Chemical analyses of the various samples were made by the Division of Chemistry. Analyses were also made of 430 boll weevils which had been killed by ingestion of calcium arsenate. These analyses showed that it would be necessary for a boll weevil to eat all the poison on a bud or equivalent surface in order to obtain a fatal dose. It is very doubtful if the feeding punctures or egg punctures made in two or three days' time would be numerous enough to cover the surface of a square two-thirds grown. The majority of weevils die the first two days after an application is made. Previous results show that nearly 60 per cent of weevils that are killed die from poison picked up on the surface of the plants, rather than from ingesting it while actually feeding.

This work indicates that weevils obtain the greater part of the poison which kills them by picking up small particles of the dust when traveling about over the plant. Experiments on control of weevils upon hirsute varieties of cotton are being conducted and compared with the control gained under similar conditions upon varieties having less pubescence.

Life History of the Cotton Hopper and Its Control

In the experiments on hibernation of the cotton flea hopper it was found that a few of the eggs laid on or before September 1 are capable of withstanding the high temperatures of September and remaining dormant in the weeds until spring. The number of eggs carried over winter in the principal weed host plants was surprisingly large. Hatching began in spring on March 7 and was practically completed by the first of June. The nymphs hatched in maximum numbers on April 6. The importance of early fall destruction of the weed host plants is strongly emphasized. This is a direct measure in helping to prevent infestation the following spring.

During the spring of 1926 there was a severe and unprecedented infestation of the cotton flea hopper that was practically universal in all counties of the State except the west, northwest, and southeast portions. This condition became so alarming that a statewide meeting was called in July. Texas Station Bulletin No. 339 and Circular No. 40, both by H. J. Reinhard of this Division, containing information on the life history and control of the pest, appeared at a very opportune time and did much to further establish the confidence of the people in the investigations of the Experiment Station.

Throughout the summer, intensive effort has been put forward toward obtaining additional information on control measures. A large number of dusts and liquid sprays have been tested. The sulphurs have again proved to be superior to all combinations not containing sulphur.

A combination dust containing sulphur, naphthalene, and lime, and another containing sulphur and tobacco dust are especially promising.

Control of Ants on Citrus Fruits

Of the materials tested in 1925, one of the calcium cyanide dusts gave best results, but as it is now no longer being manufactured, tests have been made with other materials including calcium cyanide dusts of a similar character. The calcium cyanide dusts have proved fairly effective, but are not entirely satisfactory, although great reduction in infestation results from their application. It has been necessary to make repeated applications of these dusts in order to hold the pest in check.

Control of Scale Insects on Citrus Fruits

Work on this project was begun in December, 1925, after most of the fruit had been removed from the trees. The objective in mind was to find some effective and easy method of control of scale insects in citrus. The methods heretofore used in general are quite effective, but certain difficulties in the way of application prevent complete coverage. This study has been developed to work out more effective means of securing complete coverage to control citrus-scale insects. Spray applications of oil emulsion made according to the Government formula have been studied to determine its effectiveness and the factors concerned in its application tending to reduce its efficiency. The fumigation method is also being studied, and we have had the cooperation of the American Cynamid Company and the California Cynamid Company in the use of equipment and supplies in connection with this work. An orchard of 150 trees has been set aside for this study, and counts of approximately 100,000 scales have been made during the season. The final counts are now being secured; it will then be possible to summarize the year's work. It seems possible to state at this time that the fumigation method of control has not yet been perfected for conditions in the Rio Grande Valley. The work thus far indicates that it has some promise as an efficient and easy method of control.

Boll Weevil Control by Use of Airplanes

During the season of 1925, six thousand acres of cotton were dusted commercially in Texas by means of airplanes. In order to determine the efficiency of this method of control under Texas conditions, cooperation was arranged with Captain J. C. Tips, Jr., Manager of the Super Rhone Engine and Flying Corporation of Houston, and with B. C. Roberts of Wharton, owner of a 500-acre tract mostly in cotton. W. L. Owen, Jr., of the Division of Entomology, was stationed in Wharton and has taken data showing the progress of the boll weevil infestation and the development of squares, blooms and bolls on both poisoned and untreated areas. Three applications were made, the first July 27 and the last August 10. Eleven thousand two hundred pounds of calcium

arsenate were distributed at an average rate of a little more than nine and one-half pounds per acre per application. An infestation of cotton leaf worms interfered somewhat with the final outcome, as it was necessary to make an additional application of poison to all plats in order to prevent loss of foliage on the untreated areas. The yields are not yet complete, but indicate that the poison was effective in reducing the boll weevil damage on the treated areas.

Sulphur and Sulphur Compounds as Fungicides and Insecticides

This is a joint project and is being carried on in cooperation with the Division of Plant Pathology and Physiology. Because of the impatient desire of cotton farmers throughout the State for latest information on control of the cotton flea hopper, most of the entomological work under this project has been with reference to the control of this particular insect. The funds available under this project have enabled us to conduct a broad and extensive series of tests in which other materials in addition to sulphur were also used. Abundant evidence has been obtained to prove that sulphur has reached the point where it may be considered as a standard insecticide.

Foulbrood Inspection Work

Texas is one of the few states now having less than 2 per cent of its colonies infected with the most dreaded disease of bees, American foulbrood. During the year 1925-1926 American foulbrood was found to exist in 19 of the 64 counties where inspections were made. Approximately one per cent of the 24,744 colonies examined were infected. All cases of the disease were destroyed by burning, this being the second successive year that this practice has been followed. No European foulbrood was found.

There have been two resignations in the inspection force. C. E. Heard resigned December 31, 1925, to take up the management of his own apiary, and C. S. Rude resigned February 1, 1926, to accept a better paying position in a neighboring State. Otto Mackensen and Gillis Graham were appointed as inspectors February 1.

The number of colonies inspected does not equal the average of other years. This is due partly to the fact that we could not call upon local inspectors for help in the more distant sections of the State, there being no funds provided for this purpose.

One complaint was filed with the Travis County Attorney against a man who moved his colonies when they were in quarantine. The case is still pending.

During the year 1925-26, 36 queen breeders' apiaries were inspected and certificates granted to the owners. General satisfaction was expressed with the system, inaugurated in the spring of 1925, of having all copies of certificates printed under contract and distributed from this office, thereby insuring uniformity of printed certificates. Seven thousand nine hundred copies were distributed this year.

The following is Resolution No. 4 unanimously adopted at the annual meeting of the Texas State Beekeepers Association held at College Station August 3 and 4, 1926:

"Whereas, The inspection force of the State of Texas operating under regulations promulgated by the State Entomologist has given satisfactory and efficient service and has placed the State of Texas in an enviable position in the control of bee diseases; therefore, be it

"Resolved, That it is the sense of this meeting that there should be no change in the regulations which would lessen their effectiveness or would let down the bars in any way."

Beekeeping Investigations

The work under this project is conducted at the State Apicultural Research Laboratory, located twelve miles east of San Antonio, in Bexar County, and at the queen-rearing yard, near San Antonio, and at bee outyards located at Dilley, Frio County; Roxton, Lamar County; and Seguin, Guadalupe County. All the work of the Apicultural Research Laboratory is carried under the general project "Beekeeping Investigations," and is in some way connected with beekeeping. The project was so broad that it was found necessary to divide the work up into sections or sub-projects. The sub-projects naturally group themselves under the following heads:

1. Studies in Bee Behavior—Responses of bees to temperature, humidity, barometric pressure and light.
2. Studies in Bee Nutrition—Honey plants, pollen plants, propolis, substitute foods. Cultivation of such plants.
3. Studies in Bee Breeding—All problems relating to queen breeding, drone influence, and relative subjects.
4. Studies in Bee Products—Honey, wax, beebread, propolis, royal jelly, and so forth.
5. Studies in Bee Relationship.
6. Studies in Bee Disorders, diseases, poisons, accidents.
7. Studies in Bee Economics.
8. Studies in Bee Distribution.
9. Studies in Beekeeping Equipment.

A number of experiments have been outlined and carried out according to the headings immediately above. The following brief summary is given of the work during the year:

The climatic conditions of the past year were about normal in reference to general farming. The drouth of the middle of winter and the cold, wet spring were detrimental to the best development of honey plants and of bees.

This year has been a very productive one at the Apicultural Laboratory. All experiments have given fair to excellent results. Texas Station Circular No. 35, "Suggestions on Queen Rearing," was published during the early part of the year. Three other publications are in prepa-

ration. The following results are considered as outstanding for the year:

1. By weighing colonies of bees and studying the weights in connection with weather data collected at the same time, it has been developed that bees do not work in the field after the temperature reaches 94 degrees Fahrenheit and with the humidity below 60. The amount of honey used by a normal colony in this section from November to February is 8 pounds. The amount used after that time is in direct proportion to the number of times the temperature falls below 57 degrees Fahrenheit, but is not directly related to the length of time the temperature is below 57.

2. Crimson clover, Hubam clover, and Biennial White Sweet clover were grown successfully when sown under the same conditions and at the same time as fall oats, all of these clovers being excellent honey plants under conditions at the Laboratory.

3. It has been determined that under the conditions here a queen that has not laid eggs by noon on the eleventh day after emergence will probably never do so.

4. The work with honey plants thus far indicates that with the proper distribution of native *Monarda* or horsemint seed a honey flow of double the present length can be obtained.

5. The Laboratory has distributed approximately 1,000 well-bred queens each year, resulting in an increased interest in pure-bred bees known as heavy honey producers.

6. The line breeding work of the Laboratory, accompanied by the test of individuals, has shown a marked increase in honey production over the record of the queen used as the race mother.

Agronomy

Projects

1. Oat Investigations and Oat Improvement; State funds; ———, leader.
2. Rotation, Fertilizer, and Soil Improvement; State funds; E. B. Reynolds, leader.
3. Plant Introduction Studies; State funds; E. B. Reynolds, leader.
4. A Fundamental Study of Inheritance in Cotton; Adams and State funds; D. T. Killough, leader.
5. Crop Variety Tests; State funds; E. B. Reynolds, leader.
6. Time and Method of Intertillage; State funds; E. B. Reynolds, leader.
7. Time and Method of Seed-bed Preparation Studies; State funds; E. B. Reynolds, leader.
8. Crop Improvement; State funds; E. B. Reynolds, leader.
9. Rate and Distribution of Seed and Time of Thinning Cotton; State funds; E. B. Reynolds, leader.

10. A Study and Improvement of the Peanut; State funds; H. F. Morris, leader.

11. Composting Raw Rock Phosphate and Sulphur with Different Soils; State funds, and cooperative funds from the Freeport Sulphur Company; E. B. Reynolds, leader.

12. Rice Improvement and Method of Production Tests; State funds, and cooperative funds from the Barrett Company; E. B. Reynolds and R. H. Wyche, leaders.

13. Inheritance in Grain Sorghums; Adams and State funds; A. B. Conner and R. E. Karper, leaders.

14. Wheat Breeding; State and Hatch funds; —————, leader.

15. Run-off Water Losses in Relation to Crop Production; Purnell funds; A. B. Conner, D. Scoates, and R. E. Dickson, leaders.

16. Inheritance of Head Characters in Kafir; Purnell Funds; A. B. Conner and R. E. Karper, leaders.

Oat Investigations and Oat Improvement

The oat investigations are conducted at the Main Station, at College Station, and at Substation No. 5, Temple, and Substation No. 6, Denton. At both the Main Station and at Temple a Red rust-proof oat, T. S. No. 1415, has been rather consistently the highest-yielding variety. At Substation No. 6, Denton, where many nursery plantings of head selections have been carried, the most outstanding strain obtained to date is a selection which has been named and increased for distribution to farmers. This strain has an average yield of 93.52 bushels to the acre for a period of six years at the Denton Station, and is being distributed to farmers under the varietal name "Nortex." A supply of seed has been placed with the Denton County Pure Seed Association and with other interested farmers in North Texas, and it is believed that a number of centers for pure seed of this variety will be established for its wide distribution and use in the future.

Rotation, Fertilizer, and Soil Improvement Investigations

(a) **Rotation and fertilizer experiment, Main Station.**—This experiment has been conducted since 1914. It consists of a four-year rotation of corn, oats (cowpeas), cotton, and cowpeas in comparison with continuous cotton and continuous corn. Seven different treatments are used: Acid phosphate; acid phosphate and cottonseed meal; acid phosphate and manure; rock phosphate; rock phosphate and manure; manure alone; and crop residues removed. These treatments are given to each crop in the experiment.

The results with corn, oats, and cowpeas were unsatisfactory on account of extreme drouthy conditions in the season of 1925. The results from the cotton range from 183 to 235 pounds of lint to the acre in the rotated areas, as compared with a range of from 45 to 59 pounds of lint to the acre where cotton was grown continuously, showing marked

increases on the rotated land under the conditions existing during this season. The largest cotton yield in both the rotated and the continuous cotton resulted from the application of 200 pounds of acid phosphate and 100 pounds of cottonseed meal to the acre, indicating that both rotation and the use of fertilizer are desirable for the maximum yield.

For the twelve-year period, 1914-1925, the application of five tons of manure and 200 pounds of acid phosphate produced the highest yield—215 pounds of lint to the acre in the rotated cotton, as against 180 pounds of lint per acre for the cotton grown continuously on the land and receiving the same treatment as the rotated land. As an average of all the treatments, rotated cotton produced 193 pounds of lint to the acre, and continuous cotton 150 pounds of lint to the acre for the twelve-year period, or an annual gain of 43 pounds of lint cotton to the acre. The results, to date, indicate that the soil needs a change of crops and both nitrogen and phosphoric acid, and that fertilizers alone without a change of crops or without the addition of organic materials have not given profitable results.

(b) **Soil fertility and moisture conservation studies at Lubbock and Spur.**

—The object of this work is to find a suitable cropping system or systems, including soil-improving crops and practices, best adapted to conditions prevailing in Northwest Texas. At Lubbock, there are 25 different cropping systems, which include cotton and feterita continuously, manured and unmanured, and in all combinations with fallow and green manure, using sorgo as the green-manure crop. The work was established in 1914. It was revised at Spur in 1924, omitting the fallow and adding an annual legume as a green-manure crop to compare with sorgo. These rotations at Spur were removed to a new location for the reason that they had been conducted previously on soil known to vary considerably in productiveness.

The results were satisfactory at Lubbock in 1925. The largest yield of cotton was 279 pounds of lint to the acre in a 3-year rotation of cotton manured, feterita, and fallow. The yields, however, ranged from 40 to 279 pounds of lint to the acre. The largest yield of feterita, 33.5 bushels to the acre, resulted from a 3-year rotation of cotton, feterita manured, and fallow, but the yields ranged down to 6 bushels to the acre.

For the 11-year period, 1915-1925, the 3-year rotation of cotton, feterita, and fallow manured has produced the highest average yield of cotton, 293 pounds of lint to the acre. The largest yields of feterita have been produced where manure has been used in the cropping system.

The yields of both cotton and feterita were low at Spur in 1925, the second year of the experiment in the revised form. The alternation of grain sorghum and cotton made the next highest yield of both cotton and grain sorghum, the yields being 88 pounds of lint cotton and 9.6 bushels of feterita to the acre, respectively.

The results of the work at Lubbock indicate that fallow is not neces-

sary in the agriculture of the region, and that so far, sorgo used as a green manure has not been profitable. It would appear from the results obtained to date that perhaps the most practicable cropping system for the region is the alternate cropping of cotton and the grain sorghums, using the manure and crop residues available.

(c) **Rotations.**—At practically all of the substations where agonomic work is conducted, rotation of crops is practiced for two reasons: first, as a matter of good farm practice; and second, to observe the effects of rotation on the yield of crops grown and on the soil and to record and accumulate data thereon. In general, rotation has produced considerably larger yields than continuous cropping to one crop. For example, on the Main Station Farm, College Station, cotton in a 4-year rotation of corn, oats, cotton, and cowpeas made an increase of 43 pounds of lint to the acre a year over the yield of continuous cotton for the last ten years. Corn in the same rotation and for the same period produced approximately 6 bushels an acre annually more than continuous corn.

Rotation of crops at Substation No. 5, Temple, has practically controlled root rot of cotton, although it has not entirely eradicated the disease.

Plant Introduction

Plant introduction was carried out in the usual manner at the Main Station and at the substations in 1925. Subterranean clover, a recent introduction, continues to do well at the Main Station, Substation No. 4, and Substation No. 11. Circular No. 37, "Subterranean Clover," was published in the fall of 1925.

Andropogon annulatus, which has been grown at Angleton since 1915, has been found to be well adapted to the central and eastern parts of the Gulf Coast of Texas. So far this grass has had no appropriate common name and for this reason it has been named "Angleton Grass." Bulletin No. 342, "Angleton Grass," is in the hands of the printer at this time. The Australian winter pea and purple vetch have done well at Substation No. 6, Denton, and purple vetch at Substation No. 3, Angleton, for the last two years.

A Fundamental Study of Inheritance in Cotton

Satisfactory results were obtained in 1925 despite the extreme drouth. The more important studies made were as follows:

(a) **Inheritance of quantitative characters.**—The following characters were studied on 125 hybrid lines of cotton in the first, second, third, and fourth generations:

1. Length, strength, and uniformity of lint.
2. Percentage of lint.
3. Size of boll.
4. Percentage of 4- and 5-lock bolls.

5. Earliness as measured both by daily bloom count and open boll count.

6. Height of plant.

7. Yield of lint and seed.

8. Weight of 100 seeds.

9. Lint index.

Some qualitative studies, such as color of flowers, leaves, and stem, hirsuteness, and storm resistance, were also made on this material.

This material is being analyzed and studied at this time, but as yet no definite conclusions have been reached on these studies.

Pedigree progeny rows of Startex cotton have been studied with respect to earliness, yield, and length of lint. In these studies it has been found that the percentage of lint has been increased from approximately 32 per cent to 37 per cent without affecting other desirable characters, such as length of lint, earliness, and yield.

In a study on the length of lint in an in-bred strain of Mebane cotton it has been found that lint from different bolls on different parts of the same plant and even in the same boll and on the same seed varies considerably in length. A bulletin on "Variation in Certain Lint Characters in a Cotton Plant and its Progeny" has been prepared for publication.

(b) **Hybridization studies.**—In this work crosses were made in the spring of 1926 as indicated below to study the inheritance of these characters:

1. Virescent yellow leaf X normal green leaf.

2. Brown lint X white lint.

3. Red leaf X virescent yellow leaf.

4. Long lint X short lint.

5. Early maturity X late maturity.

6. Large boll X small boll.

7. Slick seed X fuzzy seed.

8. Leaf showing plastic chlorophyll deficiency X normal green leaf.

This material, of course, is not yet ready for analysis.

(c) **Study of seedling vigor.**—These studies, conducted in the greenhouse, were begun in 1923 and have been continued up to the present time. Some of the characters studied are: rate of germination, seedling vigor as related to mature plant characters, chlorophyll deficiencies as expressed by chlorophyll-deficient areas in the leaves of seedling cotton, holding of the seed coat ("seed-held") after germination, and abnormal leaf. The study of chlorophyll deficiencies has been published in Bulletin 333, "Heritable Chlorophyll Deficiencies in Seedling Cotton." In the study of seedling vigor and its relation to certain characters in the mature cotton plant, it was found that there was significant positive correlation between seedling vigor and yield of lint cotton. A manuscript dealing with seedling vigor in relation to mature characters in the cotton plant is being prepared for publication.

Crop Variety Tests

The usual tests with varieties of different crops were conducted at the Main Station and substations during the year of 1925. The results with several crops are given as follows:

(a) **Variety tests with cotton.**—These tests were conducted at all the substations in 1925, but the results were rather unsatisfactory on account of the drouth. The data summarized for all the stations to date continue to show that the Mebane, Lone Star, Truitt, and Acala types of cotton are best adapted to conditions in Texas. These varieties have more or less local adaptation. For instance, Rowden, which is adapted to Central and Eastern Texas, is too late in maturity for Northwest Texas. Perhaps the most striking result is that New Boykin is one of the highest-yielding varieties where it has been grown, especially in Central Texas.

Drag tests are being made on the varieties of cotton, on cotton with different fertilizer treatments, and also on bolls of cotton maturing at different times, to determine the effect of fertilizer and time of maturity on length and strength of cotton fibers.

(b) **Variety-date tests of corn.**—This work was conducted at some of the substations and at the Main Station in 1925. In most cases the results were not satisfactory on account of the extreme drouth. A summary of all this work to date at the several substations shows that Surcropper, Chisholm, Ferguson Yellow Dent, Fentress Strawberry, Hastings Prolific, Thomas, and Brazos White are the best-yielding varieties of corn for the eastern half of Texas. The results of these experiments also show that corn should be planted early in any given locality if maximum yields are to be expected.

(c) **Variety test of cowpeas.**—A summary of the results of variety tests of cowpeas at the substations shows that New Era, Brabham, Early Bluff, and Blackeye are good varieties for conditions in Texas. Perhaps New Era, Groit, and Brabham are better adapted to all of the conditions in the State than the other varieties.

Time and Method of Intertillage Experiments

The object of this project is to determinate the effects of different methods of cultivation and the presence and absence of weeds on the yield, development, composition, and quality of crops; and also on the structure, moisture, and fertility of the soil. So far the work has been devoted largely to the crop-production phase of the matter. The experiment is carried on at Chillicothe, Lubbock, Spur, and Beeville.

Six treatments are included: (1) Cultivate once; (2) cultivate twice; (3) cultivate three times; (4) cultivate four times or frequent cultivation; (5) permit weeds to grow undisturbed, and (6) remove weeds with the hoe but give no cultivation. Cotton, corn, and milo are the crops grown. The most striking result in 1925, as usual, was obtained from the plats on which the weeds were permitted to grow undisturbed; these plats produced practically a crop failure. The re-

sults for the 8 years, 1918-1925, inclusive, show that the destruction of weeds is the principal consideration in tillage operations. These results also show that just enough cultivation to control weeds effectively is the best kind of tillage, and the ordinary cultivator is perhaps the most effective implement for this purpose.

Time and Method of Seed-Bed Preparation Studies

These investigations are conducted for the purpose of securing data on the effect that different methods, depths, and time of preparing the seed-bed have on yield and character of crops grown; and also the effects of the treatments on the tilth and fertility of the soil. The following methods of preparation are used: (1) Listing deep (7 inches) and shallow ($3\frac{1}{2}$ inches) in the fall, in winter, and in spring; and (2) plowing deep (7 inches) and shallow ($3\frac{1}{2}$ inches) in fall, in winter, and in spring; (3) disking in the fall, in winter, and in spring; and (4) listing at planting time. Cotton, milo, and wheat are the crops used. This work has been conducted since 1918 at Chillicothe and Lubbock.

The field work was satisfactory in 1925. At Lubbock the largest yield of cotton, 153 pounds to the acre, resulted from plowing 7 inches deep at the medium date. For the 8 years, 1918 to 1925, inclusive, however, late plowing, both deep and shallow, has produced the highest average yield of cotton, 250 and 214 pounds of lint cotton to the acre, respectively. At Chillicothe in 1925, the best results with cotton, 252 pounds of lint to the acre, resulted from late listing at a shallow depth, while for the period 1919 to 1925 the largest yields resulted from medium to shallow listing whether it was done early or late.

The general conclusions from these investigations to date are that medium to late preparation of the seed-bed to a medium depth gives best results on soils that do not blow. On soils having a tendency to blow, later preparation is advisable.

Rate and Distribution of Seed and Time of Thinning Cotton

This project has been conducted with some modifications since 1914. The results secured in this project to date show that close to medium spacing has produced maximum yields in most parts of Texas. Twelve inches was the optimum spacing at Angleton, Spur, and Lubbock; 9 to 12 inches, at College Station; 21 inches at Beeville and Temple; 27 inches at Nacogdoches; and 30 inches at Troup and Chillicothe. Thinning cotton at the usual or normal time of thinning has produced larger yields than cotton thinned later. The results of these investigations are being published in Bulletin No. 340, "The Effect of Spacing on the Yield of Cotton."

The Study and Improvement of the Peanut

This project is being conducted at Substation No. 11, Nacogdoches. Up to 1924, sixteen high-yielding selections had been isolated. The

drouth in 1924 caused a failure of the peanuts. A few seed, however, were produced, which were planted in 1925, but with no further progress to report at this time.

Composting Raw Phosphate Rock and Sulphur with Different Soils

Since 1919 the work included in this project has been done at Substation No. 5, Temple, with sulphur as fertilizer to determine its effect on the yield and quality of the crops grown, and also to determine its effect on soil. Cotton, corn, and oats in a three-year rotation, and continuous cotton are used in the experiment. Sulphur is applied to the land in amounts ranging from 50 to 10,000 pounds to the acre. Previous to 1924 the sulphur was applied to the cotton only, the corn and oats receiving the residual effects of the sulphur, but in 1924, the sulphur was applied to the three crops.

The results of the work to date show in general that sulphur as a fertilizer has no significant effect on decreasing or increasing the yield of cotton, corn, and oats, when used in amounts up to 1500 to 2000 pounds to the acre, but larger amounts reduce the yield. These results indicate that sulphur is not needed as a fertilizer on the heavy black limestone soils of Central Texas.

Rice Improvement and Methods of Production Tests

The major work carried under this project in 1925 at Substation No. 4, Beaumont, embraced tests with varieties of rice, selections of rice, increasing selections of rice to be distributed to rice growers, and experiments with fertilizers.

(a) **Variety tests of rice.**—So far these tests show that Texas Fortuna, T. S. No. 1583, and especially selection No. 347 from Texas Fortuna; T. S. No. 5411, a Japanese rice; T. S. No. 2204, Honduras; Blue Rose; and Early Prolific are well adapted to the conditions prevailing in the rice district of Texas.

(b) **Selections of rice.**—In 1925, nine selections of Texas Fortuna, T. S. No. 1583, were increased from head row selections in 1924. Selection No. 347 appears to be the most desirable selection in this lot, since it is a good yielder and has fair milling qualities. It is being increased for distribution to farmers. About 3,500 pounds of Texas Fortuna, T. S. No. 1583, were distributed to two farmers in 1926. Texas Fortuna is the best-yielding rice we have and if a good milling strain can be obtained, it will be superior to any varieties now grown.

Lady Wright, T. S. No. 8077, is a popular variety of rice with farmers at this time. Its popularity is due to its good milling quality, early maturity, to its long, uniform cylindrical grain, and to the fact that it commands a premium on the market. This variety, however, does not make as large yields as Texas Fortuna. Selections of this variety were made in 1925 with the object of obtaining high-yielding strains.

(c) **Fertilizers.**—The object of the work conducted with fertilizers on rice is to determine the fertilizer requirements with respect to:

1. Elements needed, whether nitrogen, phosphorus, or potash, or any two or all of them in combination.
2. The combination and amounts of these elements giving maximum results with respect to yield and milling quality.
3. The optimum time of applying fertilizers to rice.

The present status of this work shows that sulphate of ammonia at the rate of 100 pounds to the acre has been the most profitable treatment. Acid phosphate alone or in combination with sulphate of ammonia has not increased the yield. The results on the time of applying fertilizers show that best results were secured when the materials were applied to the rice about six weeks after planting.

Wheat Breeding

The work carried under this project is conducted principally at Substation No. 6, Denton, and Substation No. 5, Temple.

At Substation No. 6, Denton, the wheat-breeding work in 1925 included extensive nursery plantings of new head selections as well as a continuation of previous head selections in nursery row, comparative trials in larger blocks with a large number of pure lines, variety tests with winter and spring wheats, trials with hybrid wheats, rust nursery observations, and the increase and distribution of superior pure lines and varieties. The primary objective of the wheat breeding at this point is to develop rust-resistant, high-yielding strains of wheat possessing good milling quality and particularly adapted to the wheat region of North Texas. Neither leaf rust nor stem rust was a troublesome factor this year, but extreme heat and drought during maturity reduced the yields of small grain.

Thirty-two pure line selections of Mediterranean, T. S. 3015, were grown in comparative tests. These selections yielded 10 to 16 bushels to the acre. Selections 3015-66, 3015-26, 3015-106, 3015-129 were among the highest-yielding strains of this lot, all yielding above 14 bushels to the acre.

Fifty-eight pure line selections from Mediterranean wheat grown in comparative tests for four years, 1922-1925, have ranged in yield from 17 to 24 bushels to the acre as an average for this period. Several of these pure lines possessing high yields and outstanding in other desirable characteristics have been deemed worthy of increase and distribution. Selections 3015-66 and 3015-106 are two of the highest-yielding strains for the four-year period, with average yields of 23.14 and 22.58 bushels, respectively. These two selections also have rust-resistant qualities.

Thirty-two selections of winter wheat from Ferguson Seed Farms grown since 1923, varied in yields from 8.55 to 16.90 bushels to the acre. The highest-yielding selection of this lot averaged 28.06 bushels for the three years under trial. The most promising of these selections will be tested further in comparison with established varieties.

Kanred X Marquis wheat hybrids obtained from the Kansas Station,

have been grown since 1922. A summary of yields shows none of these crosses superior to the Kanred parent although earliness and greater rust-resistance are pronounced in a few of these selections.

In a variety test consisting of seven varieties of Durum and Hard Red Spring wheats, the Durums, in general, produced better than Red Spring varieties. Acme produced the highest yield.

In the variety test with winter wheat, 1925, Clark's Blackhull, Mediterranean, and Kanred yielded 16.66, 15.45, and 14.55 bushels to the acre, respectively. Mediterranean and Kanred are the two leading varieties for this region but Clark's Blackhull has excelled these two varieties in yield for the last two years.

A large number of original selections made from a native strain of Mediterranean wheat resulted in the isolation of a number of types from which have been propagated many pure-line selections. A number of these selections are very promising from the standpoint of yield, quality, rust resistance and freedom from lodging. The best pure-line wheat, T. S. 3015-66, has been increased and placed in the hands of farmers growing pure seed in North Texas for further increase and distribution in the wheat-growing regions of the State. The station will continue to further increase this wheat for distribution to farmers so far as facilities will permit. This new wheat has been named "Denton" and is a medium-tall, strong-stem, rust-resistant, high-yielding, brown-chaff, bearded wheat.

The investigations with wheat at Substation No. 5, Temple, in 1925, consisted of the regular variety test, tests of pure-line wheats, and head-row selections. Clark's Blackhull has been one of the best varieties at Temple.

Cotton Ginning

Under this project a study is being made of the effect of speed of saws, the effect of the use and non-use of the cleaning apparatus, and condition of the roll (tightness) on the percentage, length, grade, and quality of lint. The project is in actual operation at this time and samples of lint are being taken under the different conditions of ginning.

Run-off Water Losses in Relation to Crop Production

Purnell Project No. 209, entitled "Run-off Water Losses in Relation to Crop Production," the field work of which is done at Substation No. 7, Spur, is a project of statewide importance, inasmuch as it deals with the factors concerned in the losses of water by run-off. In almost every part of Texas water is a limiting factor in crop production, and until we understand the factors involved in water losses by run-off and their relative importance, it is unlikely that systematic and most effective practices will be followed in conserving the water for the use of the growing crop. The chief factors studied in this project are: the intensity of the rainfall; the slope of the land; the condition of the land; and terraces or other obstructions which may retard the run-off of water.

The literature on this subject is being assembled and digested, including the available information from the past rainfall records at Spur and other points in Texas during the past fifteen years. In the study of this problem a series of control plats has been established, each bordered by sheet-iron so as to catch the rainfall on its own area. At the lower end of the areas, concrete tanks have been installed to catch the run-off water. These control plats comprise areas with different slopes, different physical conditions of the soil, and different crops. The data obtained are to be used as basic data in connection with field areas ranging approximately eight acres in size, terraced or otherwise equipped for obstruction of the run-off flow. Equipment has been secured for six of these field areas. One is now complete and in operation, and the other five will be installed and in operation this winter. The equipment for these field areas consists of automatic water-stage recorders set up over a weir to measure the outflow of water from the different areas with different types of obstructions. The intensity of the rainfall is being obtained by the use of an automatic rain-gauge which gives ten-minute reading on rainfall throughout the rainfall period. The measured loss of water from the control plats and from the field areas will be studied in connection with the crop yield to determine the relation between the water saved and the crop produced. The installation of equipment in connection with this project has required considerable time, and the results obtained during this season have, necessarily, been of only preliminary value, in that it has been necessary for the soil areas, particularly in the control plats, to become re-established before reliable data could be obtained. The results obtained thus far indicate that a large amount of water is lost by run-off; that the intensity of the rainfall, the percentage of water in the soil, the condition of the soil, the crop on the land, and the type of obstruction are all important factors.

Inheritance in Grain Sorghum

The present year's work, involving selective inbreeding within eight kafir lines with a view of studying the inheritance of head characters, rounds out ten generations of selection and inbreeding. Detailed records on individual self-fertilized plants have been kept for this period and used for correlation studies to determine the relationship between the different characters involved and particularly the relationship between these characters and yield of grain. Multiple correlation between eleven head and plant characters and production of grain, calculated from population material and also from line-bred material, gave a coefficient of $.934 \pm .003$, when calculated on population material, and $.926 \pm .009$ when calculated on line-bred material. This comparatively high correlation coefficient indicates that, while many of the characters bearing on production have been taken into consideration, there yet remains to be considered other characters exerting an influence on the production of grain. Partial, or net, coefficients have been calcu-

lated from both population and line-bred material and furnish a basis of comparison with the zero order coefficients calculated from this same material for the purpose of a more complete analysis of the true relationship between the various head and plant characters being studied and their bearing upon each other and upon production.

The effects of ten generations of inbreeding within these eight pure lines of kafir has been to reduce materially the variability of all the characters measured and the establishment of individuality in these lines through their approach to homozygosity. There has been no apparent loss in vigor and production.

Material for study of the inheritance of four head characters in kafir was obtained by hand-crossing two of the line-bred strains, Nos. 223 and 654, having widely different means for these characters. The characters involved are: number of seed branches, number of nodes to the head, length of rachis, and length of seed-bearing branches. The two parental lines were crossed in 1922 and the F_1 generation grown in 1923. The cross and its reciprocal of these hybrids were planted in 1924 and the second generation, consisting of approximately 200 individual plants for each cross, was obtained for study and further analysis. Complete record for the phenotypic classification of the second-generation material was made and in 1925, 215 progeny head rows from the second generation of one of the hybrids were grown for genotypic analysis. The necessary data for such analysis have been secured under Purnell Project No. 212.

A study of hybrid vigor in grain sorghums has shown that where closely related varieties or forms are crossed, such as Blackhull kafir x Red kafir, Dwarf milo x Standard milo, and Dwarf feterita x Standard feterita, such crosses are accompanied by little or no hybrid vigor, as indicated by height of plant, whereas, where crosses were made between widely different forms, such as kafir and milo and milo and feterita, marked hybrid vigor is expressed in both the F_1 and F_2 generations. On the basis of height as a measure of heterosis, crosses between Dwarf Yellow milo and Extra Dwarf feterita resulted in an increase over the maximum parental height of 54.83% in the F_1 generation and an increase of 25.02%, based on the mean heights of a total progeny of 234 plants, in the F_2 generation.

Inheritance of Head Characters in Kafir

This project has for its objective the collection and analysis of data from 215 progeny rows planted from second-generation seed and involving the measurement of more than 21,000 heads for four characters; number of seed branches; length of seed branches; number of nodes to the head, and length of rachis. The measurements on the entire lot of seed have been completed and the work of assembling the data is now in progress. A review of the data in their present form rather indicates that the inheritance of number of seed branches may be

simple, but that the inheritance of some of the other characters is complicated, involving qualitative inheritance.

Plant Pathology and Physiology

Projects

1. Texas Root Rot Investigations; Adams and State funds; J. J. Taubenhaus, leader.

Sub-project: A Root Rot Study at Substation No. 9.

Sub-project: Control of Texas Root Rot of Alfalfa and Related Crops.

2. Tomato Diseases; Hatch and State funds; J. J. Taubenhaus, leader.

3. Diseases of Cabbage, Lettuce, and Spinach in Texas and Their Control; Hatch and State funds; J. J. Taubenhaus, leader.

4. A Study of Pecan Scab and Related Diseases of the Pecan; Hatch, State, and cooperative (with School of Agriculture) funds; J. J. Taubenhaus and G. W. Adriance, leaders.

5. A Study of Diseases of Perishable Crops in Transit and Methods of Control; cooperative funds from Western Weighing and Inspection Bureau; J. J. Taubenhaus, leader.

6. Preliminary Studies with Sulphur or Strong Bordeaux Causing What is Termed "Burning" of Foliage in Cucurbits; Sulphur funds; J. J. Taubenhaus, leader.

Cotton Root Rot

A study of the cotton root rot disease is being made covering the entire State of Texas. The cause of the disease has been definitely determined by artificial inoculations, and considerable progress has been made in the study of the life history of the causal organism. We have obtained spores of the causal organism in pure culture, and this definitely confirmed Dr. Duggar's work to the effect that the root-rot fungus is not a sterile organism. These spores have also been found in great abundance in South and West Texas under irrigation conditions. Data on hand seem to indicate that the fungus spreads underground by means of root contact. Experiments on clean fallow showed that it is possible to reduce considerably the percentage of root rot by reducing the number of weed carriers. In Central Texas the main weed carrier was found to be *Ipomoea trichocarpa*, and this weed has proved itself a most difficult one to eradicate. In South and West Texas the *Ipomoea trichocarpa* is practically of no importance, but there are other weed carriers to be reckoned with. Of the large number of families the plants of which are susceptible to root rot, perhaps the Convolvulus, the Compositae, and Leguminosae families contain by far the largest number of susceptible hosts. Considerable difficulty has been experienced in germinating the spores of the root-rot fungus. Treatment of the spores with a weak soap solution gives a small percentage of germination, but in every case the germinated spores seem to produce a very short germ tube and then

fail to develop further. Work will continue along these lines, as it is absolutely necessary to definitely determine the part which these spores play in the life cycle of the causal organism.

In the past, it was believed that a plant when once affected by root-rot would suddenly wilt and die in a short time. Definite studies made the past year along these lines brought out the fact that the effect of the disease in totally destroying its host depends on the time of the year in which infection takes place. For instance, when young seedlings are infected early in July they do not necessarily die immediately after the roots have been affected. They are found to alternately wilt and revive for a period of four to ten weeks before the affected plant finally collapses and dies. Such plants invariably make an effort to produce new roots and in this way manage to hold their own and keep alive, although they are practically worthless as far as cotton production is concerned. Such plants really are more dangerous, because by struggling to maintain life they also maintain the root-rot fungus.

The symptoms of some 200 individual affected cotton plants have been studied, and the results of these studies will be given in a forthcoming publication.

During the progress of the work it became more and more necessary to determine whether the root-rot fungus spreads by means other than root contact. Although no definite results have as yet been obtained in that direction, some of our studies in staking affected plants have yielded some very valuable information. For instance, it was found that infection and the spread of the causal organism from one plant to another is not as rapid as it was first believed to be. The rapidity of the spread seems to be influenced by the age of the plant and possibly by conditions of concentration of the plant sap, and also by the season itself. For instance, we find that when plants are infected during early July it may take 1 to 126 days before the adjoining plant shows infection, if it becomes affected at all. If we remember, as has already been stated, that an infected plant does not necessarily die at once, it would seem that the causal fungus remains alive with the host in a more or less dormant state and is able to slowly spread to the adjoining plant. On the other hand, as the season advances and the plants become older, the time necessary for the spread of the fungus and infection of adjoining plants varies only from 1 to 5 days. At this stage, of course, the roots of the plants have completely developed and the underground contact is more nearly complete. Work is now in progress in an effort to determine whether the root-rot fungus can spread underground irrespective of the host, notwithstanding our work has previously shown that the fungus dies with the host.

An effort was made to determine the tolerance of the root-rot fungus to an alkaline or acid media. Pure cultures of the causal organism were grown in NaOH (sodium hydroxide) and in hydrochloric acid. In each case, various amounts of hydrochloric acid were added to the

media to make it neutral, acid, or alkaline, and the pH value of the media definitely determined. It has been noted that the extreme limit of growth of root-rot fungus varies from 8.85 pH alkaline to 4.05 pH acid. Furthermore, the best growth was obtained at 8 pH value alkaline and at 6 pH value acid. On the acid side the fungus was completely checked at a pH value of 4.05 and on the alkaline side at a pH value of 8.85. These studies seem to indicate that it may be possible to control root rot in some soils by changing their reaction either to a point of acidity below 4 pH reading or a point of alkalinity above 9.00 pH reading.

Parallel with the above studies, samples of soil were collected from various parts of the State where root rot is known to be very prevalent, and also from parts of the State where this disease is of little importance or altogether absent. The pH values of these soils were determined by the Division of Chemistry, and in general the results obtained seem to support the laboratory studies reported above. More work is in progress along these lines.

This year a careful morphological study was made of the spores of the root-rot fungus as they occur in the field in West Texas. It was possible to demonstrate the various stages which take place in the development and the formation of the spore itself.

Tomato Diseases

During the year no active laboratory work has been carried out under this project except collecting field data of the various tomato diseases as they occur in East and South Texas. It appears more and more that concentrated research is necessary to determine some of the perplexing problems of plant disease as they confront the tomato growers of the State. It is highly desirable to determine the possible effect of fertilizer, especially potash, on the carrying quality and the prevention of decay in transit. It is also very necessary to determine the cause of what appears to be a new trouble known to growers as "puffing." This trouble not only reduces the carrying qualities of the tomatoes, but there seems to be an associated heart rot which seems to go hand in hand with puffing. Whether this is a different trouble or is the result of puffing is unknown.

Diseases of Cabbage, Lettuce, and Spinach

The work under this project during the year has consisted altogether of rounding up the work on a new spinach disease caused by *Fusarium solani*. The result of this work has been submitted as a Texas Station Bulletin, which is now in press.

Pecan Diseases

No progress has been made on the project of pecan diseases. This is a project carried in cooperation with the Department of Horticulture of the College, but no results were obtained during the year. Perhaps

the greatest pecan disease as it occurs on the College campus is die-back, and certainly this disease presents a problem that should be worked out.

Diseases of Perishable Crops in Transit

This is a project carried on with cooperative funds furnished by the Western Weighing and Inspection Bureau, and in cooperation with the various railroads of the State. In this connection, damaged specimens are being received from the various railroads of the State. Many of these specimens are from commodities as they are shipped from other states into Texas, or those that are grown in Texas. In this work a wealth of data is gradually obtained as to the kind of diseases of fresh fruits and vegetables which occur in transit, and an effort is being made to determine the cause. Valuable information is also being gathered as to the important diseases which are being introduced from other states into Texas.

Effect of Sulphur on Foliage of Cucurbits

Work has been continued at Texas Substation No. 15, Weslaco, on the possible effect of sulphur in controlling powdery and downy mildew of cantaloupes. The work this year has again definitely shown that sulphur in any form cannot be used on cucurbit leaves without serious burning injury. Various fungicides have been tested out and compared with sulphur, but so far no fungicide has been found which can be recommended to the growers of South Texas which would control powdery or downy mildew without burning or seriously injuring the foliage. Our work on sulphur is progressing and an effort is being made to determine its effect as a fungicide or a germicide. Work in this direction, however, has not gone far enough to report on it.

Plant Disease Survey

In this connection we are gathering information on the prevalence of plant-disease epidemics in the State, and send in monthly reports to the Bureau of Plant Industry, United States Department of Agriculture. These data, when they are compiled, will be used in connection with other data obtained on soil temperature, to be published at some early date.

Farm and Ranch Economics

Projects

1. Dairy Marketing Research in Texas; cooperative (National Farm Bureau Federation) funds; G. L. Crawford, leader.
2. Taxation Problems in Agriculture; in cooperation with Bureau of Agricultural Economics; State and cooperative funds; F. A. Buechel and C. O. Brannen, leaders.
3. A Study of Ranch Organization, Methods and Practices, and Costs of Range Live Stock Production in the Edwards Plateau Region of Texas; in cooperation with Bureaus of Agricultural Economics and Animal Industry, U. S. Department of Agriculture; State, Purnell,

and cooperative funds; L. P. Gabbard, G. S. Klemmedson, and V. V. Parr, leaders.

4. A Study of Costs and Methods of Range Live Stock Production and Ranch Organization in the Northwestern Range Area of Texas; in cooperation with the Bureaus of Agricultural Economics and Animal Industry, U. S. Department of Agriculture; L. P. Gabbard, for Station; G. S. Klemmedson, for Bureau of Agricultural Economics; and V. V. Parr, for Bureau of Animal Industry, leaders.

5. A Study of Farm Organization, Methods and Practices and Costs of Production of Farm Products in a Typical Blackland Cotton Farming Area of Texas; in cooperation with Bureau of Agricultural Economics; Purnell, State, and cooperative funds; L. P. Gabbard and J. B. Hutson, leaders.

6. Factors Influencing the Marketing of Winter Vegetables in the Lower Rio Grande Valley of Texas; Purnell and State funds; L. P. Gabbard, leader.

7. A Study of Short Term Farm Credit in Texas; Hatch, State, and cooperative (with School of Agriculture) funds; V. P. Lee, leader.

8. Local Cotton Marketing Study; Purnell and State funds; G. L. Crawford, leader.

9. Range Vegetation of the Edwards Plateau; State funds; V. L. Cory, leader.

10. Activities of Live Stock on the Range; State funds; V. L. Cory, leader.

11. Study of the Carrying Capacity of the Pastures of the Ranch Experiment Station in Sutton-Edwards Counties; State and local funds; B. Youngblood, L. P. Gabbard, V. L. Cory, and E. W. Thomas, leaders.

Dairy Marketing Research in Texas

The field work under this project was completed during the year, the data assembled, and a manuscript submitted for publication. This manuscript, however, was considered as being in need of revision, and the material is being reworked and revised for resubmission. The data show that Texas is a heavy deficit area in so far as dairy products are concerned, particularly butter. It is believed that on the completion of the study of the data much valuable information will be forthcoming.

Taxation Problems in Agriculture

A study of the trend of taxes on agricultural land in Texas and the distribution of the farmer's tax-dollar was completed during the year and the material published as Texas Station Bulletin No. 334, "Trend of Taxes on Agricultural Land in Texas and Distribution of the Farmer's Tax-Dollar." This study showed marked increase in the amount of taxes paid by the farmer, and that the greater portion of these taxes was levied for local purposes.

A Study of Ranch Organization, Methods and Practices, and Costs of Range Livestock Production in the Edwards Plateau Region of Texas

This study was carried on by the route method, dealing with 25 ranches in the year 1925 and 28 ranches in the year 1926. It is a detailed analysis of the business, dealing with costs, methods, and other operations concerned with the organization of a ranch. The data are being put into the hands of ranchmen concerned, so that they may have an opportunity to compare their business with other businesses in the same section. The study is an effort to get accurate records first-hand from a group of ranches in the Edwards Plateau region for a period of three to five years, and the work on this project to date has been very largely on the nature of collection of data to be assembled and analyzed when available over a sufficient period of time to give a reliable basis for conclusion.

A Study of Farm Organization, Methods and Practices, and Costs of Production of Farm Products in a Typical Blackland Cotton Farming Area of Texas

This project is very similar to the project dealing with the ranch problem, going perhaps into more detail, as it is concerned with a typical blackland farming section. In 1925, data have been collected from 23 farms and in 1926 from 27 farms. These data are to serve as an aid in developing more profitable systems of farming for the region.

A Study of Costs and Methods of Range Livestock Production and Ranch Organization in the Northwestern Range Area of Texas

This study, having continued over a period of six years, has been carried long enough to consider the data reliable and representative of the conditions there. The data have been assembled and are now being edited preparatory to submission for publication.

Marketing of Winter Vegetables in the Lower Rio Grande Valley

The work under this project was begun the summer of 1925, the object of which is to determine the nature and extent of various factors met in the production and marketing of winter vegetables, and to show the relation of these factors to the marketing of such vegetables in the Lower Rio Grande Valley. The field data for this study are now being completed and will be tabulated and summarized during the coming year. It is impractical to attempt to interpret these data at this stage of their development.

Short-Term Farm Credit in Texas

This is a study of short-term farm credits based on data collected from 455 farms, 52 banks, and 179 merchants. The data have been assembled, tabulated and digested, and a manuscript has been submitted for publication. This study deals with the amount of credit being used, the time involved, sources from which it is available, the

purpose for which it is used, the rate of interest, and, in fact, is intended to develop some useful information in connection with short-term credit needs of the farmer.

Local Cotton Marketing Study

This project has as its primary object the determination of the extent to which local markets discriminate between the different grades and staples of cotton, and to what extent the prices paid in central markets are reflected in prices paid on the local markets. Cotton samples are being collected at four points in Texas, namely, Robstown, Henderson, Hillsboro, and Lubbock, by a field man at each place. These samples are to be secured daily throughout the ginning season, and, as they accumulate, are to be sent in for expert classing and stapling and for further study. The collection of data thus far in connection with this project has proceeded in a highly satisfactory manner. A large number of samples have been secured, with complete data on each, and it is believed that the study will not only provide data as to the classes and grades of cotton produced in the different regions, but, as well, information as to the extent to which the local market reflects the true market value of that class and grade of cotton.

Range Vegetation of the Edwards Plateau

This study has been previously carried on under Project No. 163, "The Carrying Capacity of the Pastures of the Ranch Experiment Station." It was thought that the problem of determining the character and economic importance of native vegetation of the Edwards Plateau region for grazing purposes was important enough to be developed into a separate project. Mr. V. L. Cory, Grazing Research Botanist, is the leader of the project. One area in each of the six pastures of the Ranch Experiment Station has been laid out to be studied in detail. Up to date about 580 plants have been identified and collected, most of them common to the Edwards Plateau region. The study of these areas should give definite information as to the type and character of range feed available throughout the season, the composition of same with respect to species, and chemical analysis of the principal species, and information that will lead toward the better utilization of range lands by grazing them in such a way as to favor the development and maintenance of the most important species occurring and perhaps discourage the unimportant and undesirable kinds.

Activities of Livestock on the Range

This study was also originally a part of Project No. 163, referred to above. The object of this project is to observe and record the behavior of live stock on the range with the view of obtaining definite information as to their requirements and their preferences for range forage. Data have been collected on this project since December, 1923. In 1925, observations were made in the months of January, April, and

August. These data are being tabulated and summarized for each year. This study is a sort of companion study to the vegetation study, in which the habits and preferences of animals utilizing the range feed are the chief factors.

Carrying Capacity of Pastures of the Ranch Experiment Station

"Study of the Carrying Capacity of the Pastures of the Ranch Experiment Station in Sutton-Edwards Counties" was originally Project No. 163. As it stands now, the vegetation studies and the observation work on range live stock have been developed into separate projects and no longer form a part of this project. This study, however, is very closely associated with the two mentioned, the carrying capacity being determined by the weights maintained and the gains made from the different pastures, the results to be correlated with the two projects mentioned, and particularly with the vegetation study. Data have been collected and tabulated for the years 1924 and 1925, and the 1926 records will have been completed by January 15, 1927.

Practices and Costs of Harvesting Wheat and Other Small Grain with the Small Combine, Binder and Header

This Division has cooperated during the year with the Federal Bureau of Agricultural Economics in securing schedules on the practices and costs of harvesting wheat and other small grain with the combine, binder and header. A project is to be submitted covering this work. Eighty-two schedules have been secured from farmers in the region of Perryton and Spearman, Texas, all of whom used the combine and some of whom used either or both the binder and header in harvesting their wheat. These data will be tabulated and summarized not later than January 1, 1927.

Soil Survey

During the year the soil survey work was continued in cooperation with the Bureau of Soils, United States Department of Agriculture. About two thousand square miles were surveyed during this period. The survey of Milam County was completed about the first of the fiscal year and the report and map forwarded to Washington for preparation. During the early part of the year, surveys were started in Victoria, Navarro, Willacy, and Van Zandt Counties. These are being continued at this time; the work in Van Zanda County, however, was discontinued for the summer as it was being worked entirely by Bureau of Soils men who were assigned to areas in Northern States during this season.

The force of regular soil surveyors numbers three men, while an equal number or more is furnished by the Bureau of Soils. The purpose of the soil survey is to collect information about the soils of the State for use by all who are interested in agriculture and the work is incorporated in published maps and bulletins which are issued to the

public. The data are secured in the field and are basic work dealing with soil classification and production and definitely outline the basic agricultural resources of a county in so far as these are related to the soils. Each soil type is shown on the map as to its location and extent and the report gives its relative and actual suitability for specific crops, its requirements, and all other information that may be secured. The greatest resources of the State are the soils and on the utilization of these soils rests the prosperity of the State. The soil survey is designed to outline these resources in such a way that they can be used the most advantageously. Soil survey work has been carried on for twenty-five years in Texas and thus far about 17 per cent of the State has been covered by detailed surveys, while about 52 per cent has been given general reconnaissance surveys.

The work during the year has been done in areas representing certain important regions of the State. The survey of Willacy County will practically complete all of the lower Rio Grande Valley region, where a great interest is being manifested in many special crops such as fruits, vegetables, and certain farm crops. The soil survey will be of great aid in furnishing a foundation for the study of the many particular problems which have to be dealt with, such as soil problems, drainage, irrigation, insect pests, plant diseases, and other problems. The new station in this district, Substation No. 15, is studying many of the special problems and by means of the soil surveys the results will be made more individually applicable to every farmer.

The survey of Victoria County will give needed information concerning the soils and agriculture of the Gulf Coast prairie, a large region of Texas where ranching is gradually giving way to intensive crop production. Many of these soils are found to be very productive and where good drainage is given, crop yields are very good. Studies as to fertilizer requirements of some of the thinner sandy soil types are also necessary.

Navarro County lies in the great Blackland belt of Texas, where special problems of insect pests and fungus plant diseases require attention, and where problems relating to crop diversification are attracting more and more attention. The soil survey will furnish a basis on which to approach the solution of these problems.

Van Zandt County lies in the great East Texas sandy timber belt, and here the question of soil utilization is becoming more prominent. Certain of the soils are especially suited for the production of cash crops other than cotton, and the soil survey will indicate these and furnish data for studying the fertilizer requirements of the soils.

Some special work was done by the soil surveyors on calls from certain large agricultural projects. Examinations and reports were made on the soils of some large irrigation projects in the vicinity of Cotulla and San Antonio. A visit was made to Dickens County to acquaint the farmers with the soil types suitable for the production of alfalfa,

this information being required before the published soil survey report of that county have been printed. On request of extensive sugarcane growers in Cuba, a soil surveyor from the Station staff spent several weeks there making special soil alkali determinations in the field with the Wheatstone bridge to determine the amounts of soluble salts in certain soil types.

During the year the report of the soil survey of Dickens County was published. Mr. H. H. Bennett, the Bureau of Soils Inspector for this district, spent several weeks in the State during the year, correlating the soil types and passing on the work done.

Botany

The activities of the Division of Botany have been concerned chiefly with assembling herbarium specimens, with special reference to range vegetation, studies being made at the Sonora Station and at the Loin Disease Field Laboratory, in which a knowledge of the existing specimens under range conditions is important and necessary. Similarly, it has been desirable to study the vegetation in Rockwall and Dallas Counties, in the Brownsville area, and in the forest areas of East Texas. This work has an intimate relation to the development and utilization of the resources of the several sections, and it is therefore important that permanent records be made of the plants collected for use in the study of problems which may arise from time to time in the different regions.

Swine Husbandry

Projects

1. Cottonseed Meal for Maintaining, Growing, and Fattening Hogs; State and local funds; Fred Hale, leader.
2. The Effect of Adding Various Minerals to a Fattening Ration for Hogs; State and local funds; Fred Hale, leader.

Cottonseed Meal for Maintaining, Growing, and Fattening Hogs

This study of cottonseed meal for hogs is designed to determine whether prime cottonseed meal, when fed in amounts sufficient to balance the ration, may be safely fed to brood sows during their gestation period, lactation period, and to growing and fattening hogs. The three sows used in this experiment are kept constantly on a ration of Milo 75 parts, cottonseed meal 15 parts, and wheat gray shorts 10 parts. One-half pound of salt and 1.5 pounds of finely ground limestone are added to each 100 pounds of feed. The sows are kept on pasture as much as possible. In September, 1925, one of these sows farrowed 12 live, normal pigs, and another sow farrowed 15 live, normal pigs. The third sow failed to conceive. This was the fourth litter of pigs farrowed by these sows on the cottonseed meal ration. In March, 1926, one of the cottonseed meal sows farrowed 15 pigs, one farrowed 12 pigs, and one farrowed 9 pigs. All of these pigs were live, normal

pigs, and weighed on the average at birth about the same as pigs out of sows fed on tankage. All of these sows are due to farrow in September, 1926, which will be the sixth litter on the cottonseed meal ration. In other words, these three sows have been fed a 15 per cent cottonseed meal ration since November, 1923, and during this time they have received no animal protein from any source.

Two gilts were saved from the March, 1925, litters for the purpose of developing to get a second generation. Both gilts have been raised on the above cottonseed meal ration; however, some oats were used while the gilts were maturing. The cottonseed meal used in their ration, however, amounted to 15 per cent of the ration since the gilts were old enough to eat in a creep. Both of these gilts are as large as their dams, and both gilts are due to farrow in September, 1926, thus giving a second generation of pigs on a 15 per cent cottonseed meal ration. Two boar pigs were saved from the March, 1926, litters, and they are being developed on the cottonseed meal ration similar to the ration fed the two gilts mentioned above. These two boars will be used to breed a few sows in order to study further the effect of a cottonseed meal ration upon their breeding qualities.

As for the effect of using cottonseed meal for fattening hogs, one lot of 10 pigs from the March, 1925, farrow was placed in a dry-lot test on July 19, 1925. They averaged 98 pounds when placed on test, and were fed for 70 days on a ration of six parts milo and one part cottonseed meal by weight. Before these pigs were placed on this dry-lot test, they had been receiving the above ration since they were old enough to eat in a creep, and had been running on pasture. One pound of bone meal was added to each 100 pounds of feed. These pigs made an average daily gain of 1.15 pounds, and required 381 pounds of feed per 100 pounds of gain. The weather was so hot that at no time during the test did these pigs consume as much as five pounds of feed per day per pig.

One lot of 12 pigs from the September, 1925, farrow was placed in a dry lot January 15, 1926. They averaged 89.8 pounds when placed in this dry-lot test, and were fed for 70 days on the following ration: ground milo 75 parts, wheat gray shorts 10 parts, prime cottonseed meal 15 parts. Two pounds of a mineral mixture composed of 75 per cent bone meal and 25 per cent salt was added to each 100 pounds of feed. These pigs had been getting 15 per cent cottonseed meal in their ration since they were big enough to eat in a creep. They were fed for 70 days in a dry lot, and during this time made an average daily gain of 1.32 pounds, and required 377.8 pounds of feed per 100 pounds of gain. These pigs were fed a 15 per cent cottonseed meal ration 180 days, including this 70-day dry-lot test without any ill effects, and good gains were made by these pigs while in dry lot.

The pigs farrowed by the cottonseed meal sows in March, 1926, are on test now, and the test will not close by the end of the present fiscal

year. At the present time these pigs are gaining a pound per day, and have been in dry lot since they were weaned. They weighed 50 pounds average when placed in dry lot. They are getting milo 85 parts, prime cottonseed meal 15 parts, and a mineral mixture composed of limestone and salt.

These studies seem to indicate that sows can produce as large litters when fed a ration balanced with prime cottonseed meal as can sows when fed a ration where tankage, skim milk, or any kind of animal protein is used to balance the ration. Where the ration has been properly balanced, the pigs have made good and economical gains on a ration balanced with cottonseed meal in these tests, and have eaten this ration for a period of 180 days with no ill effects.

Tests are now in progress which point to the fact that cottonseed meal gives much better results when fed with milo, if certain minerals are supplied in addition.

Effect of Adding Various Minerals to a Fattening Ration for Hogs

A study of the effect of adding various minerals to a fattening ration for hogs has as its object the determination of the effect of such minerals with reference to rate of gain, and amount of feed required per unit of gain. Minerals which have been used in these tests include salt, limestone, hardwood ashes, air-slaked lime, and bone meal. The fattening rations used include ground milo balanced with 60 per cent digester tankage, and ground milo balanced with prime cottonseed meal. These tests have shown that minerals fed in addition to a milo and tankage ration do not increase the efficiency of the ration, since no increased gains were made and as much feed was required where minerals were added as in rations without minerals to produce 100 pounds of gain. This holds true where minerals were added to the ration up to 2 per cent of the ration, or where minerals were added to the ration and self-fed also.

Where minerals were added to a milo and cottonseed meal ration, increased gains were very significant. Lot 1, which received a ration composed of ground milo 85 per cent, and prime cottonseed meal 15 per cent, gained 836 pounds during a 100-day test. There were 10 pigs in this and the next three lots, and the initial weight of the pigs in each lot was 52 pounds. Lot 2 received the same ration as did Lot 1, except 0.5 per cent salt was added to the ration, and salt was also self-fed in a box. This lot of pigs gained 994 pounds or 158 pounds more than did Lot 1. Lot 3 was fed similarly to Lot 1, except 1.5 per cent finely ground limestone was added to the ration, and limestone was self-fed in a box also. This lot of pigs gained 993 pounds in 100 days, or 157 pounds more than did Lot 1. A fourth lot of 10 pigs was fed similarly to Lot 1, except that a mixture of limestone and salt was fed in addition. This lot of pigs gained 124 pounds more than the lot receiving straight milo and cottonseed meal.

These tests show that increased gains are secured where either salt

or finely ground limestone is added to a ration of milo and cottonseed meal. Lots 2 and 3 made 100 pounds of gain on less feed than did Lot 1, requiring 371.8 and 374.8 pounds of feed, respectively, for 100 pounds of gain. Lot 4 required as much feed to make 100 pounds of gain as did Lot 1, namely, 386.4 pounds. Lot 1 did not eat so much feed as did Lots 2, 3, and 4 during this 100-day test. Lot 1 ate a total of 3231 pounds of feed, Lot 2 ate 3696 pounds, Lot 3 ate 3722 pounds, and Lot 4 ate 3710 pounds of feed during the 100-day test. All of the above lots were hand-fed twice daily and each feed was wet to a thick slop at feeding time.

Chemical analysis shows that 60 per cent digester tankage contains 18 to 22 per cent ash, a good part of which is calcium. Both milo and cottonseed meal are low in calcium, sodium, and chlorine. There seems to be enough salt in tankage to satisfy the needs of the fattening pig according to these results. Salt and limestone, however, proved to make a milo and cottonseed meal ration more efficient.

Dairy Husbandry

Projects

1. Constructive Breeding of Dairy Cattle; State and local funds; G. P. Grout and J. L. Lush, leaders.

2. Value of Rice By-products as a Feed for Dairy Cows; local funds; J. L. Lush and Fred Hale, leaders.

Constructive Breeding of Dairy Cattle

The object of this study is to improve the herds in production, constitution, size, type, and color of animals, to learn whether there is any difference between families in resistance to infectious abortion, and to study the inheritance and general behavior of these characteristics, to the end that a constructive breeding program can be devised which can be followed by dairymen with more certainty of good results.

All the records made by the cows at Substation No. 10 have been corrected for age and to a standard 305-day lactation period. Analysis has shown that the average mature equivalent 305-day record in the experimental herd up to January 1, 1926, has been 5514 pounds of milk and 282.5 pounds of fat. Fully one-fourth of the cows, however, had records above 6343 pounds of milk and above 324 pounds of fat. One bull used for several years had increased the fat percentage of the herd very slightly (not nearly enough to be statistically significant) and had done nothing to the milk yield. The other bull used during the same period did practically the same thing. The first heifers of the bulls used later are just beginning to freshen.

Prediction formulae for the breeding value of bulls and cows have been developed which are believed to be more accurate and to be founded on more nearly correct genetic principles than any formulae now in use. A statement about the use of these formulae is now in preparation for the Journal of Dairy Science.

Development of these formulae has required considerable time and study. We expect to test them out in our herd in the future to make sure that they are fundamentally sound. After that has been demonstrated, we will try to present them in the simplest possible accurate form for popular use. Our efforts at present are, therefore, being directed toward testing the validity of these formulae and incidentally toward breeding up our own herd to a higher level of production. Measurement and weight records and photographs at certain ages are being taken regularly.

Value of Rice By-Products as a Feed for Dairy Cows

The object of this study is to determine the suitability of rice bran as a feed for dairy cows.

Three double reversal feeding tests of 90 days each with rice bran were carried out this year. The results of these tests have been written up and are soon to be published as a Station bulletin. In general, rice bran was found to have about the feeding value expected on the basis of its chemical composition; that is, about 75 per cent to 80 per cent as much as corn chops. It was demonstrated conclusively that good rice bran does not injure the flavor of whole milk even when fed in very large amounts.

Poultry Husbandry

Projects

1. Breeding as Affecting Egg Production; State and local funds; R. M. Sherwood, leader.

2. Comparison of the Value of Protein from Vegetable Sources with Protein from Animal Sources When Fed to Laying Hens; local funds; R. M. Sherwood, leader.

3. Comparison of Various Feeds for Young Chickens; local funds; R. M. Sherwood, leader.

4. Studies of Variation in Hatching Quality of Eggs; Hatch, State, and local funds; R. M. Sherwood, leader.

Breeding as Affecting Egg Production

This study includes a test of the capability of certain cockerels to transmit high egg-production tendencies to their progeny. Cockerels that prove to be prepotent in this respect are in turn used on the better hens of the Station flock to increase production. The progeny test during the year furnished data relative to the breeding qualities of certain cockerels. Summarizing this work, a marked difference was shown in prepotency with respect to high egg-production in the progeny. Another part of this study is the improvement of the strain of White Rock fowls by the introduction of Barred Rocks, and later eliminating the color factor. This work has just begun. Further studies are being made on the data already collected on the relation between body characters and egg-production, and the zero order and partial correlation

coefficients between the various characters and egg-production for 14 characters were determined. The results would tend to show that some of these measurements are duplicate measurements for the same character, and these are being studied on another population at the present time.

Comparison of the Value of Protein from Vegetable Sources with Protein from Animal Sources When Fed to Laying Hens

This project has been carried on actively for the past six years. Data secured at the present time show that cottonseed meal is a useful protein for supplying egg-production. Egg-production was practically as great from the hens on cottonseed meal as from those on meat scrap, and the mortality was lower among the hens on cottonseed meal. Studies are also being made of the value of minerals in the rations, and also the effect of the rations on the keeping quality of eggs.

Comparison of Various Feeds for Young Chickens.

No work has been carried on under this project during the year, the results in growing chicks not being satisfactory to the extent to make it advisable to carry on the work. It is hoped that work on this project may be resumed during the coming season.

Studies of Variation in Hatching Quality of Eggs

This project has been carried on actively for three years. Data have been secured from 62 individual hens and 21 different flocks. The eggs from the individual hens ranged in hatchability from 0.0 per cent to 100 per cent. The 21 different flocks ranged from 32 per cent to 77.1 per cent of the total eggs set. The average hatch of the 50,520 eggs set this year was 69.8 per cent as compared with 65.3 per cent last year. Seasonal conditions, flock management, handling conditions and the breed of the fowls are factors which cause differences in hatchability of eggs.

Feed Control Service

The Division of Feed Control Service is the agency through which the provisions of the State pure feed law are enforced. No change in the general policy of inspection and enforcement has been made during the year. Feed inspectors have visited feed manufacturers, feed dealers, and a large number of customers, in order to secure official samples for analysis, to weigh packages of feeding stuffs to prevent selling short-weight feeds, and to detect other possible violations of the feed law. Feed inspectors file weekly route-lists with the Chief of the Division, and these are revised by him whenever necessary. In addition, each inspector is required to submit a daily report of his activities. During the past year, feed inspectors on official duty traveled 72,372 miles, and visited 10,613 firms in 1655 towns and cities, and secured 1708 official samples of feeding stuffs, which were subjected to chemical analysis, and analyses were also made of 129 registration samples and 83 special samples, making a total of 1920 samples analyzed

during the year. The cooperation with the Bureau of Chemistry, United States Department of Agriculture, has been continued, under which have been drawn and reported to the Federal authorities twelve samples of feeding stuffs, representing shipments made in violation of the Federal Food and Drugs Act of 1906.

The system of reporting the results of inspection has not been changed. Results of the inspection of feeds are reported to the manufacturer, the dealer, and the consumer, in order that all parties interested may know to what extent the feed law is being obeyed. When the analysis of a shipment shows it to be adulterated or misbranded, the dealer is notified and advised to remove the feed from sale, and failure to follow instructions leaves no option except to file legal proceedings for violation of the feed law.

During the year, dealers have been advised to remove from sale 413 shipments of feed, manufactured by 206 different firms, and amounting to 2,870,200 pounds, for the reason that the feeding stuffs involved did not meet the requirements of the law. Untagged shipments were relabeled, and the sales of feeding stuffs below guarantee were adjusted by the manufacturers' paying proper rebates to dealers and consumers when the deficiencies were sufficient to warrant such rebates. Fourteen complaints were filed, four of which are still pending. Out of the ten cases settled, eight fines were paid, one case was dismissed, and one defendant was tried and found "not guilty."

Representatives of the Division have attended conventions of the Association of Official Agricultural Chemists of North America, the Association of Feed Control Officials of the United States, the Association of Food, Feed and Drug Officials of the South Central States, the Texas Grain Dealers Association, and the Texas-Southwestern Cattle Raisers Association. In the Association of Food, Feed and Drug Officials of the South Central States, the Chief acted as a member of the Committee on Feeds and Fertilizers and as Chairman of the Executive Committee. In the Association of the Feed Control Officials of the United States the Chief is President and a member of the Committee on Definitions and Standards for Wheat Mill Feeds and a member, ex-officio, of the Executive Committee.

Following the usual custom, two semi-annual conferences of feed inspectors with the Division officers have been held. The September, 1925, conference was held at College Station, and the April, 1926, conference was held in Waco.

Agricultural Engineering

During the year, two projects relating to the field of agricultural engineering have been in progress, through cooperation with the Department of Agricultural Engineering of the School of Agriculture, Agricultural and Mechanical College of Texas. Project No. 211, "A Study of the Cotton Planting Dropping Device," has involved detailed

study of the various cotton planting droppers and the collection of data looking toward a better understanding of our present planting equipment, and pointing the way to possible improvement in planting devices. The present trend of planting cotton, particularly in the West, where conditions for planting are more or less ideal, as a rule, putting on the land what is desired in the way of a stand and thus avoiding the expense of thinning the cotton, shows the importance of a detailed study of planting devices in keeping abreast of the rapid advances being made in crop farming and the general efficiency of production.

A second project dealing with agricultural engineering problems, Project No. 209, "Run-off Water Losses in Relation to Crop Production," is carried on under the Division of Agronomy and involves the study of the factors concerned in the losses of water by run-off. This is an important problem, involving many phases of agricultural engineering which have to do with conserving rainfall on the land for use in growing crops, and thus minimizing the amount of water turned into our streams. The report on this project is given under the Division of Agronomy.

The research field in agricultural engineering is an important one in Texas and should be expanded as facilities permit.

Publications

The activities of the Division of Publications during the year have consisted largely of supervising the work of the Publications Committee, through which all publications of the Station must pass before being finally submitted to the printer; the necessary work in editing and proof-reading manuscripts, and finally the distribution of the printed publications to best advantage.

The question of the distribution of Station publications has become a very important one, in view of the fact that the issues must, of necessity, be limited. It has become necessary, after the required number of copies have been sent, to hold a large part of the issue in reserve to be sent out on request, and in order to meet the requirements of the large number of citizens who desire the publications of this Station, a policy of issuing a summary bulletin from time to time, including digests of a given number of publications, has been adopted, sending these summary bulletins as issued to the entire mailing list, thus meeting the needs of a large number of readers who are concerned only with a brief statement of the findings. This summary bulletin also serves as notice to those desiring copies of the bulletin or bulletins reported, and they can obtain them by writing the Director. This bulletin announcing Station publications and some of the outstanding results also aids in putting the work of the Station before the citizenship of the State.

The mailing list of the Station at this time contains a total of

70,927 names. This list is being revised periodically, so as to maintain a live mailing list.

An effort is being made to strengthen the Station Research Library facilities by maintaining exchanges with other research agencies, both domestic and foreign.

Publications Issued

The following is a tabular statement of the fourteen bulletins, five circulars, and one annual report issued during the fiscal year:

Number	Number of Pages	Number Copies in Edition	Total Number of Pages in Edition
Total.....	757	291,500	8,164,000
Bulletin No.			
332.....	19	10,000	190,000
333.....	22	6,000	132,000
334.....	42	7,500	315,000
335.....	46	7,000	322,000
336.....	142	8,000	1,136,000
337.....	47	7,000	329,000
338.....	12	75,000	900,000
339.....	39	12,000	468,000
340.....	77	14,000	1,078,000
341.....	28	16,000	448,000
342.....	11	14,000	154,000
343.....	24	8,000	192,000
344.....	40	10,000	400,000
345.....	59	10,000	590,000
Circular No.			
37.....	14	10,000	140,000
38.....	13	11,000	143,000
39.....	23	8,000	184,000
40.....	8	40,000	320,000
41.....	28	12,000	336,000
Annual Report:			
38th for 1924-25.....	63	6,000	387,000

In addition to the research bulletins and circulars printed by the Station, the workers have prepared and submitted for publication in scientific journals and the press 19 contributions on various subjects coming within the field of their investigations. A list of these contributions is as follows:

1. Experiments with Brahma Cattle; J. L. Lush, Animal Husbandman, Breeding Investigations; The Cattleman.
2. The Inheritance of Horns, Wattles, and Color in Grade Toggenburg Goats; J. L. Lush, Animal Husbandman, Breeding Investigations; The Journal of Heredity.
3. Controlling Sex; J. L. Lush, Animal Husbandman, Breeding Investigations; The Breeders Gazette.
4. The Importance of a More General Appreciation of Research; A. B. Conner, Vice-Director, Texas Agricultural Experiment Station; The Progressive Farmer.
5. Jujubes; W. B. Lanham, Chief, Division of Horticulture; The Dallas News.
6. Contributions of the Land-Grant Institutions to National Agricultural Progress; B. Youngblood, Director, Texas Agricultural Experiment Station; read before Section on Agriculture, Thirty-ninth Annual Convention of the Association of Land-Grant Colleges, Chicago, Illinois.

7. Relation of the Purnell Act to Modern Life; B. Youngblood, Director, Texas Agricultural Experiment Station; read before the Texas Society for Vocational Education, Dallas, Texas.
8. Method of Selecting Wool Samples in Studies on Shrinkage Determination; J. M. Jones, Chief, Division of Range Animal Husbandry; read before the American Society of Animal Products, Chicago, Illinois.
9. The Inheritance of Horns, Wattles, and Color in Goats; J. L. Lush, Animal Husbandman, Breeding Investigations; given before Genetics Section of the American Association for the Advancement of Science, Kansas City, Missouri.
10. Culling; J. L. Lush, Animal Husbandman, Breeding Investigations; The Cattleman.
11. Studies in Ranch Economics: A Method for Measuring Carrying Capacity; B. Youngblood, Director, Texas Agricultural Experiment Station; The American Farm Economics Association, New York City.
12. Run-off Water Losses in West Texas; A. B. Conner, Vice-Director, Texas Agricultural Experiment Station; The Progressive Farmer.
13. Soil Surveys in Texas; W. T. Carter, Supervisor State and Federal Soil Surveys in Texas; The Progressive Farmer.
14. Damage of Fresh Fruits and Vegetables from Freezing; J. J. Taubenhause, Chief, Division of Plant Pathology and Physiology; read before the Southwestern Claims Conference, Dallas, Texas.
15. How Breeds are Made and Improved; J. L. Lush, Animal Husbandman, Breeding Investigations; The Cattleman.
16. Some Observations on the Rambouillet Sheep Breeding Industry in Texas; J. M. Jones, Chief, Division of Range Animal Husbandry; Tillotson Directory of Pedigree Stock Breeders and Yearbook of the Breeding Industry.
17. Are Experiment Station Results Held Too Long? A. B. Conner, Vice-Director, Texas Agricultural Experiment Station; The Progressive Farmer.
18. Damages Done by a Grade Bull; J. L. Lush, Animal Husbandman, Breeding Investigations; The Breeders Gazette.
19. The Farmer and Agricultural Surpluses; L. P. Gabbard, Chief, Division of Farm and Ranch Economics; The Progressive Farmer.

In addition to the list of contributions given, the workers have prepared a number of non-technical papers for publication in the agricultural press, and for delivery over the radio, on subjects of timely interest to farmers and to the citizenship in general.

SUBSTATIONS

The diverse soil and climatic conditions in Texas may be classified in rather well defined agricultural regions within which the problems and conditions encountered are in general very similar. It has been the policy of Texas to establish in the principal agricultural regions experimental stations or field experimental laboratories for the purpose of conducting researches within these several regions on the problems of paramount importance to them. It is manifest that one centralized experimental station, itself located within a well defined region, can never solve some of the agricultural problems common to other regions. For example, it is utterly impossible to do experimental work with rice in Central Texas, where none of the conditions necessary for the growth of rice exist. Likewise, research in the problems confronting the

sheepmen and goatmen of Texas can only be studied advantageously in the region where the conditions existing provide a normal environment for these animals. Similarly, it is difficult, or impossible, to do research work with grain sorghum outside of the region where this crop sets a full seed crop with certainty. Work with citrus fruits must be done in a region of temperatures suitable to the growing of the crop and not in a region of common low temperatures. Accordingly, the work of the substations is devoted largely to solving the problems characteristic of the agricultural regions served by them.

Since the State agriculturally is made up of distinct regions, the substation, therefore, becomes a very necessary unit in a comprehensive research system for the study of agricultural problems. The substation, therefore, through its relation to the main or parent station serves as a clearing house for sound agricultural information developed on the grounds in the region where it is located. It renders many other services to the people of the region, particularly in the introduction and development of new and suitable crops; the dissemination of good practices and economies in the production and harvesting of crops; and in the introduction of new blood lines in live stock.

There are 15 substations and six field laboratories, and yet not all of the principal regions are served. Ohio, occupying an area of only 15.52 per cent of that of the State of Texas, maintains 13 substations, and Indiana, lying adjacent and with an area 13.7 per cent of that of Texas, maintains four substations. Thus it will be seen that two states occupying an area only 29.22 per cent of the total area of Texas maintain 17 substations, to say nothing of the five main or parent stations in addition for the study of their problems. The facts in the case are that these several substations in Texas, each serving an area larger than many individual states, require much more extensive and intensive equipment than they have at the present time, together with two or three scientific investigators on the grounds, if they are to adequately serve the regions in which they are located. Even with such development of the substation, it would be rendering service at a relatively low cost as compared to service rendered in the Corn Belt, for example.

There is no gainsaying that at the present time the substations are undermanned and under-equipped, and the marvel is that they have served so well as they have in aiding the development of the agricultural regions. That the substations have been potent factors in the development of the resources in the different regions is an admitted fact; that it would be profitable to make them more productive with respect to shaping our agricultural development along sound lines would be questioned by no one familiar with the potential resources in these several regions and the rapid strides in development which often meet with temporary reverses because of a lack of sufficient information.

Substation No. 1, Beeville

Substation No. 1 is located 5.5 miles northeast of Beeville, Bee County, and is adjacent to the Galveston, Harrisburg & San Antonio Railway; latitude 28 degrees north and longitude 97 degrees west; and with an elevation of 240 feet above sea level. The average rainfall over a period of 30 years was 28.71 inches. The farm comprises 151.5 acres, of which 104 are in cultivation, 28 in pasture, 3.5 acres in farmstead, 6 acres in roads and ditches, and 10 acres in waste land. This station is located in an agricultural region which can best be designated as interior black prairie lands, principally Victoria and Goliad series of soils.

This station was established originally as a citrus fruit and vegetable station, and it may be said that its early work contributed largely to the subsequent development of citrus and vegetable growing in Southwest Texas and formed a basis for the unusual development in these fields in the Rio Grande Valley, in the Winter Garden district, and to the south. The work at this station with Satsuma oranges in particular has been of much value in developing the Satsuma industry in Southwest Texas. The station has developed and maintained a strain of corn known as Thomas corn, which is particularly well adapted to that region, and which is now perhaps the most commonly grown variety of corn in the region. The station's early work with vegetables developed the information that vegetables of good quality and in good quantities could be produced in that section, but with the subsequent development of vegetable growing to the south, the industry has given away to a considerable extent to general farming. More recent work has shown that the region is especially well suited to general crop farming, particularly with cotton, corn, and broom corn, and indicates that this type of farming in the region is susceptible to economies in production and harvesting which give it unusual advantages in this type of productive farming.

The work of this station at the present time is along the lines of propagating more hardy and more productive strains of Satsumas, and studies relating to the production, harvesting, and curing of broom corn, particularly with reference to producing not only larger acre-yields but also a product of higher quality that will accordingly command a higher market price and a higher acre-value. The station is increasing and distributing seed of the best producing strains of grain sorghum and has produced more than 3000 pounds of the Texas Blackhul kafir, one of the best producing strains developed by the Texas Station, and one which is believed will be of considerable value throughout the Blacklands region. Hegari, another promising grain sorghum which originated at the Texas Station, has been one of the outstanding varieties at this station and is coming into considerable popularity as a crop.

Much basic information has been obtained as to varieties and strains

of cotton and methods and practices of planting which it is believed will form basic information in the further development of economies in growing and harvesting cotton for market in this section. The station represents a well defined Blacklands region with its own peculiar problems which, although subject to change with the rapidly changing conditions, require the active prosecution of research for the development of information that will be helpful in shaping the development of this agricultural region along sound lines.

Substation No. 2, Troup

Substation No. 2 is located one mile northeast of Troup, Smith County; latitude 32 degrees north, and longitude 95 degrees west; with an elevation of 483.7 feet above sea level. The average rainfall over a period of 21 years was 42.49 inches. The station comprises 152.6 acres of land and is located in the central part of the region designated as the East Texas Timber Belt, on soils of the Norfolk and Susquehanna series.

This station was established to conduct systematic investigations relating to mixed and diversified truck, vegetable, and crop farming for the fruit and vegetable district of East Texas. The work includes experiments with adapted and promising nuts, fruits, berries, grapes, vegetables, and root crops, as well as with farm crops, clover, and grasses. It also includes the study of the application of fertilizer, crop rotation, and building up and maintaining soil fertility.

The principal accomplishment of the station has been the contributions it has made to the East Texas tomato-growing districts in the use of fertilizers, which has been a direct outgrowth of experiments conducted here and which has had much to do with increasing both the quality and the quantity of tomatoes grown on a given unit of land. Early fertilizer work with strawberries showed that marked increase in yield could be had by the application of cottonseed meal and acid phosphate. The work with Triumph seed potatoes from different sources showed that both the condition and the maturity of the potato planted are very important. During the past year 902 experiments were conducted. In the cotton work this year, yields as high as 364 pounds of lint to the acre were secured, this amount being practically double the acre-yield for the State. Half and Half cotton produced a staple three-fourths of an inch in length—a product which is not tenderable on the market. Half and Half was the only variety included in the test that failed to produce merchantable cotton in so far as length of staple was concerned. Its yield was the same as Kasch and slightly greater than the other varieties grown. Early-planted corn has consistently produced better than medium or late-planted.

Fertilizer work with peaches, using the Elberta variety, has given inconclusive results up to this time. The application of 20 tons of manure to the acre was the only treatment showing an increase in

yield. This fertilizer work is conducted on young trees and so far indicates that fertilizer applied to an orchard during the first three years after planting is in nowise as profitable as applications of barnyard manure.

Substation No. 3, Angleton

Substation No. 3 is located 3.1 miles northeast of Angleton, Brazoria County, adjacent to the St. L. B. & M. railroad; latitude, 29 degrees north, and longitude 95 degrees west; with an elevation of 25 feet above sea level. The average rainfall over a period of 12 years was 47.77 inches. The station comprises 159.3 acres of land, and is located in a region known as the Gulf Coast prairie, composed principally of the Victoria series of soils.

This station was located here for the purpose of aiding in the development of agriculture in the flat coastal prairie soils. The land in its raw state, being rather flat, has comparatively poor drainage, but when brought under cultivation is very fertile and productive of a variety of crops. The region is especially well adapted to forage crops, and these should perhaps remain the principal crop of this section. Much has been done to test out new forage crops, particularly grasses, which can be used for extensive planting in the improvement of meadows and ranges. Angleton grass, a species of *Andropogon*, has been found to be particularly well adapted to this section, and is becoming one of the most important forage grasses of the region. A bulletin has been published describing this grass, and large quantities of the grass have already been distributed. Japanese sugar cane is another forage crop that has been found to be very profitable.

Cotton, corn, peanuts, and cowpeas all produce well when drainage is provided. A limited amount of tile drainage has been installed in keeping with a thoroughgoing program, it being considered that drainage is one of the fundamental factors in developing a highly productive generalized farm practice. The abundance with which forages and forage crops generally can be produced indicates that dairy or live stock farming in some form should become a part of the enterprise of every farmer in the region.

Some work has been done in connection with figs, including fertilizer, control of fig rust, and the growing and production of figs so that the best crop will be available for the market. In the control of fig rust, spraying with 5-5-50 Bordeaux mixture every 30 days as soon as the disease appears gave very promising results. Spraying with the same mixture at 15-day intervals gave no better results. Spraying with 10-10-50 gave no better results than 5-5-50.

This station has as its objective the development of a drainage system and crop practices that can be successfully put to use on the farms of that section and this program requires a continuous and an aggressive policy. The importance of the work, therefore, is to justify the expenditure of a reasonable amount of time and money, as the region

served by it has great potential value, which, when developed, will add a vast amount of wealth to the resources of Texas.

Substation No. 4, Beaumont

Substation No. 4 is located six miles west of Beaumont on the S. P. and B. S. L. & W. railroads; latitude, 30 degrees north, and longitude 94 degrees west; elevation, 26.5 feet above sea level. The rainfall over a period of 33 years was 49.97 inches. The station comprises 100 acres of land located in the eastern part of the Gulf Coastal region, principally on Crowley and Lake Charles soil series.

This is an irrigated station, established in the beginning chiefly as a rice station. It is also one of the main purposes of this station to develop suitable grain and forage crops to use in connection with rice farming, and to develop the fruit and vegetable possibilities of the section.

The outstanding features of the work previously done have been working out methods of applying intertillage to rice to conserve irrigation water and to kill weeds; the development of information on fertilizer for rice, particularly with reference to time of application, which has been shown to be important in that early applications have been found to stimulate weed growth. The station has developed and tested out a number of strains of rice, the principal contribution made by the station up to the present time being the Texas Fortuna. The rice fertilizer work is being continued and has shown rather consistently that the application of 100 pounds of ammonium sulphate to the acre is profitable and that this application as a rule will give best results when applied about six weeks after planting in the case of medium-late planted rice. There is some indication that this time of application should be varied with very early- and very late-maturing varieties. The application of fertilizer 12 weeks after planting does not give the returns secured with the six weeks application, and the fractional applications are not profitable.

Fig fertilizer work conducted thus far indicates that a complete fertilizer should be used on figs. Lime also gave good results. The results secured from spraying indicate that a certain number of sprayings are desirable but that it is possible to reduce the yield by spraying too often during the season. Sprayed trees have retained their leaves two weeks longer than the unsprayed trees. Of the varieties of figs tested, the Brunswick was the heaviest-yielding variety, and the Magnolia a close second. The Brunswick, however, will not stand handling as well as the Magnolia and appears to be less desirable for preserving.

Satsumas have made fair growth, but being only in their third year, retained no fruit this year. Indications are that the Satsuma will withstand the normal cold weather of this section, and appear very promising. The Meyer lemons are maturing a fair crop of fruit, this

being the third season since planting. They give indication of being slightly less resistant to cold than the Satsuma, but otherwise they seem to thrive here.

This station has been greatly handicapped in the past because of the expense in connection with the general upkeep of an irrigation station located in a region of heavy rainfall.

Substation No. 5, Temple

Substation No. 5 is located four and one-half miles southwest of Temple and four miles northeast of Belton, and adjoins the Temple-Belton Interurban and highway. It is located at latitude 31 degrees north and longitude 97 degrees west, at an elevation of 740 feet above sea level. The station consists of 96 acres, comprising 37 acres of cultivated land, four acres of roadways, and 55 acres of pasture and waste land. The station is located in the Blacklands region in the central part of the State. The average annual rainfall over a period of 13 years was 34.98 inches.

One of the outstanding contributions of this station has been the development and distribution of Belton cotton, a strain of Rowden cotton particularly well suited to the Blacklands region. The major lines of work at this station are (1) cotton breeding, not only with a view of producing heavy yielding strains of good quality, but as well with a view of obtaining basic information for use in determining the best methods of improving cotton; (2) cotton root-rot investigations, having to do principally with the host plants of this fungus disease which tend to carry the fungus from season to season, the method of spread of the fungus, and the study of methods and practices detrimental to its existence on the land; (3) soil fertility studies embracing change of crops or rotation on the land, the use of fertilizers, and certain laboratory studies of the soils receiving different treatments, looking to the development of information as to the basic factors concerned in soil fertility in the Blacklands region.

The cotton-breeding work is concerned largely with the collection of data for determining the value of different characters in relation to production of quality and quantity—information which is urgently needed in connection with the development of superior strains of cotton. The cotton root-rot work has developed much useful information, which has been published and which is now in the course of publication for general distribution. The work developed thus far has been of such a character as to indicate rather definitely that it is possible, with a full knowledge of cotton root-rot disease, to minimize to some extent the losses sustained. The soil-fertility studies are of a basic character and therefore the work thus far is not conclusive. Soil fertility in the Blacklands, however, is a big problem and until the fundamentals involved are fully understood, the management of fields cannot be such as to maintain the fertility at a high standard. The importance of

soil fertility is realized when one considers the relation that soil fertility and the consequent vigor developed by plants may have to their resistance to insect depredation and plant diseases.

Substation No. 6, Denton

Substation No. 6 is located five and one-half miles northwest of Denton, Denton County, on the Denton-Krum pike. It is located at a latitude of 33 degrees north and longitude 97 degrees west, at an elevation of 650 feet above sea level. The station is located in an agricultural region which can be designated as Fort Worth prairie, which is for the most part black prairie soils. The station is located on the San Saba and Denton series. The annual average rainfall over a period of 13 years is 33.40 inches. The station comprises an area of 203 acres.

This station was established as a small grain and allied crops farming station. Subsequently a farm flock of sheep was introduced to be used in connection with the utilization of waste roughages and other feed on the farm. The outstanding accomplishments on this station to date have been the testing out of a large number of small grains, including wheat, oats, and barley, and the selection and development of superior producing and milling strains. The station has developed and introduced to the farmers of that region Denton wheat and Nortex oats, two crops which are now grown quite extensively in that section and promise to come into extensive use throughout the region served by this station. Another accomplishment of this station has been the development and use of sweet clover, particularly in connection with its use in the maintenance of soil fertility and in the production of a protein feed. Sweet clover is well adapted to the region and will no doubt come into general use as one of the crops on every farm. The milling quality of a number of the most promising wheats is being determined by means of milling and baking tests, as the milling and bread-making quality is an important factor as well as yield.

In addition to the experiments with small grains, work with corn, cotton, forage crops, and other allied crops that are suitable to this section in connection with small-grain farming is being conducted. Surocopper corn has consistently been one of the best producing varieties in this section.

Substation No. 7, Spur

Substation No. 7, Spur, is located one mile west of Spur, Dickens County, latitude 33 degrees north, longitude 100 degrees west, and at an elevation of 2274 feet above sea level. The average annual rainfall over a period of 15 years was 20.98 inches. The station comprises 106.35 acres of land, 104 acres in cultivation and the rest in pasture. This station is concerned not only with the development of crop farming under the conditions in this region, but also with the study of feeding and the utilization of grains and roughages produced through

feeding to live stock and thus developing for the section information that will not only enable the farmer to get the maximum returns in production, but will be helpful to him in converting his surplus feeds into money through the fattening and finishing of live stock.

The work in connection with crop farming has thus far developed much of value to the farmer of this region and of the State. The Spur feterita, which strain now comprises possibly 85 per cent of all the feterita grown in Texas, was developed at this station.

The feeding work at this station with grain sorghums has developed the fact that this grain has a feeding value approximately equal to corn pound for pound; whereas, a very short time ago grain sorghums were thought to have only 93 per cent and even as low as 80 per cent of the feeding value of corn some 20 years ago. Thus the work in grain sorghums alone has slowly but consistently shown the true value of grain sorghum as a feed, this crop being the basic grain feed crop of the West.

An outstanding project carried on this station is concerned with the study of the factors involved in the losses of water by run-off. In the entire western section of Texas, a percentage of the rainfall runs off the land into the streams and is lost to the farmer. This loss sometimes amounts to an average of 30 per cent of the total rainfall, and individual records of heavy rainfall obtained this year show a loss by run-off of as much as 90 per cent of the total rainfall at a given time. The study of the factors contributing to the loss of water by run-off is, therefore, an important study in connection with the conservation of the water on the land where it falls for use by the farmers of the western half of the State, where water is the chief limiting factor at the present time. These studies have been under way for less than a year and the results thus far may be considered as only of a preliminary nature; nevertheless, they indicate that unexpected amounts of water are lost annually to the farmers by run-off; that these run-off waters carry relatively high percentages of fertile soil; and that the losses can be minimized by a better knowledge of the effectiveness of terraces of different types.

The work with live stock has shown that it is more economical to feed crushed heads of milo than it is to thresh the grain and to feed crushed threshed grain to sheep; that there is practically no difference in the feeding value of milo, kafir, feterita, and corn when fed to sheep; that a grain feed is profitable when added to cottonseed meal and cottonseed hulls in a ration for two-year-old steers; and that this will apply even where meals are very cheap and grains very high.

Substation No. 8, Lubbock

Substation No. 8, Lubbock, is located three miles east of Lubbock, Lubbock County, latitude 33 degrees and 37 minutes north, longitude 101 degrees and 45 minutes west, and at an elevation of 3106 feet

above sea level. The average annual rainfall over a period of 15 years was 19.59 inches. The station comprises 160 acres of land, 109 acres in cultivation and the rest in pasture.

The main purpose of this substation is to ascertain facts and information upon which a sound and constructive agriculture can be developed for the section it serves. On account of its semi-arid condition and the lack of adapted crop plants native to the region it was necessary to introduce and breed crops and strains particularly adapted to the existing conditions. In this connection a great deal of valuable work has been done with sorghums, cotton, fruits, shade trees, and ornamentals.

Sudan grass has been distributed and popularized; hence it has come into almost universal use in this section of the State as a pasture and hay crop, and this region also furnishes the bulk of the Sudan grass seed grown in the United States.

Establishment of the fact that cotton is a drouth-resistant, dry-land crop and can be profitably grown on most sections of the plains has greatly hastened the settlement of that section. The leading variety of cotton has averaged 345 pounds of lint cotton per acre during the past seven years. A new early variety of cotton named Westex has been developed and distributed to farmers, which will make possible a safer extension of the cotton-producing region north and west into higher altitudes and shorter growing seasons.

Conclusive results showing that milo produces a heavier average grain yield when spaced 18 to 36 inches between plants than it does with closer spacing and that kafir produces its heaviest average grain yield when spaced 6 to 12 inches have been ascertained by experiments extending over a ten-year period.

Fundamental research with grain sorghums has developed many facts which are of value to the plant breeder working with these crops. Through breeding work with the grain sorghums at this station, this section is rapidly being developed into a center for pure seed. Distribution of high-yielding pure-line strains are constantly being made in an effort to increase the acre production of this crop and afford better planting seed for those sections which depend on the Plains for their seed stock.

Investigations dealing with soil fertility and cropping methods have been under way for several years and definite information is being accumulated.

It has been found that profitable home gardens and orchards can be maintained by supplementing the natural rainfall with windmill irrigation. Yields of 274 bushels of sweet potatoes per acre and 21,000 to 48,000 pounds of onions per acre have been recorded.

Through its experimental nursery the station has introduced and tested a large number of trees and greatly encouraged the planting of trees throughout the region. The Arizona cypress, the Chinese arbor-

vitae, red cedar, and western yellow pine have proved to be well adapted to this section of the State and are the most successful evergreens. Among the deciduous group the Chinese elm (*Ulmus pumila*), a native of China, which was introduced into West Texas in 1919, has proved highly adapted to this section. Distributions of more than 10,000 of these trees have been made throughout the State. This tree has filled a need for a rapid-growing, drouth-resistant tree for the drier regions; the result is that nurserymen of the State are now propagating it in large quantities and including it in their nursery stock of shade trees.

Substation No. 9, Balmorhea

Substation No. 9 is located four miles east of Balmorhea, on the Pecos Valley & Southern Railroad; latitude 31 degrees north, and longitude 103 degrees west; approximately 2500 feet above sea level. The average annual rainfall over a period of three years was 14.67 inches.

This station is located at the foot of the Davis Mountains, where irrigation water is available, and its work deals primarily with problems encountered in irrigation farming under the existing climatic and soil conditions of the region. The aim of this station is to make this type of farming more profitable and to encourage the development and utilization of areas suitable to irrigation under the existing conditions.

The work of the station may be divided into two general classes, namely, the horticultural and the field-crops work. The horticultural work consists largely of testing the different kinds and varieties of fruit trees, orchard, and other horticultural crops for the purpose of determining their adaptation to the particular soil and climatic conditions, and to find, if possible, root stocks which may be resistant or partially resistant to root-rot disease, which is prevalent in many of the irrigated valleys of the Southwest.

The field-crops work consists largely of testing out miscellaneous new crops and different varieties and strains of farm crops, as well as the effect of fertilizer treatments for the profitable increase of production. Acala cotton has been made a very favorable showing in comparison with other varieties and promises to be used extensively for planting under irrigation. Corn has not been found profitable here because of climatic conditions. Varieties of alfalfa have been tested and, although there seems to be some slight difference in their resistance to root rot, no one variety has shown itself to be distinctly resistant to root-rot fungus. Of the introduced varieties, the Hairy Peruvian seems to be the most promising in point of yield.

The soils of the station have responded only slightly to applications of fertilizer. Results obtained thus far indicate that it is well for farmers to try out fertilizers on small acreages before expending large sums on purchases.

Substation No. 10, Feeding and Breeding Station

Substation No. 10 is located one mile northwest of College Station, Brazos County, on the public highway; latitude 30 degrees north, and longitude 90 degrees west; 308 feet above sea level. The annual average rainfall over a period of 35 years is 37.32 inches. The lands owned and assigned to the Feeding and Breeding Station comprise 901.8 acres.

The major purpose of this substation is to provide a centralized laboratory near the Main Station and the Agricultural and Mechanical College for studies in feeding, breeding, and management of swine, dairy cattle, and poultry. The work here formerly embraced feeding work with cattle, but owing to existing conditions, this work was transferred where better facilities were available.

The work of this station is reported upon elsewhere in this report, under the heading of the divisions concerned.

Substation No. 11, Nacogdoches

Substation No. 11 is located two and three-fourths miles north of Nacogdoches, Nacogdoches County, on the Nacogdoches-Timpson highway; latitude 32 degrees north, and longitude 94 degrees west; elevation 292 feet above sea level. The average annual rainfall over a period of 24 years was 50.52 inches. The station comprises 82½ acres of land.

Substation No. 11 was established to serve the region of Texas composed principally of Orangeburg soils. The station was originally established as a tobacco station, the soils here being adapted to the growing of high-grade tobacco. The redlands of the Orangeburg classification are very productive lands, but require systematic and orderly cropping to build up and maintain fertility, and hence promote a permanent agriculture for the earliest-settled farm lands in Texas.

Experiments conducted with fertilizers indicate that increased yields are obtainable from their use, even beyond the extent to which it is profitable to use them, thus indicating the necessity for bringing the soil into better physical conditions by the plowing under of organic matter whenever possible, by the practice of a system of farming involving a change of crops on the land whenever practicable, and by the incorporation of organic matter in the soil. Terracing the land, the incorporation of organic matter of any and every kind possible at every opportunity, the changing of the crops on the land as often as possible and practicable, and subsequently the judicious use of commercial fertilizers, seem to constitute the basic needs of the soil here. It is not possible for every farmer to rigidly adhere to such a plan, but every farmer should follow such a plan as closely as it is feasible and practicable to follow it, to the end that there may be abundant choice of crops.

A variety of different crops have been grown and tested under the conditions here with a view of establishing the best crops and crop

strains, thus making available to the farmer the crops which he can use to best advantage in connection with a system of building up and maintaining soil fertility.

The station has developed an improved strain of cotton which appears to be of great promise for the conditions here, and it will probably be ready for distribution within a period of two or three years when the seed can be increased sufficiently.

An intensive study of the cotton plants in different varieties is being made in an effort to obtain knowledge as to the structural differences, such as differences in the formation of the fruiting and vegetative branches, and other differences as they are noted in the commercial varieties of cotton in use in this region.

Substation No. 12, Chillicothe

Substation No. 12 is located four and one-half miles south and one mile west of Chillicothe, Hardeman County; longitude 99 degrees west, and latitude 34 degrees north; elevation 1406 feet above sea level. The annual average rainfall over a period of 20 years is 25.74 inches. The station comprises an area of 100 acres of land and serves a region in the northern part of the Redbeds area, in which the Vernon and Kirkland series are the principal soils.

This station was established as a cooperative forage-crop testing station, operated jointly by the Office of Forage Crop Investigations of the U. S. Department of Agriculture and the Texas Experiment Station, and although this testing work has been going on for several years, it has been found to be productive work and is being continued vigorously by assembling and testing out forage crops from every part of the world for their value as crops under the conditions of the region and of Northwest Texas in general.

Among the early initial introductions which have proved to be of value to Texas are Sudan grass, feterita, and hegari, all of which were introduced and tested out for the first time at Substation No. 12, Chillicothe.

Subsequently, experimental work has been introduced here with cotton and wheat, and extensive plant breeding work is being carried on, particularly with sorghums and cotton. Two varieties of sorghum, Chiltex and Premo, resulting from plant-breeding work at this station, have been introduced among farmers and these varieties are meeting with widespread approval in certain sections. These represent the results of hybridizing kafir and feterita, and are pioneer field crops that have been obtained by hybridization work. They show the great possibilities of hybridization in sorghum as a means of securing new varieties.

Substation No. 14, Sonora

Substation No. 14 is located 26 miles southeast of Sonora, on the Sonora-Rock Springs road; latitude 30 degrees north, and longitude

100 degrees west; elevation, approximately 2400 feet above sea level. The annual average rainfall over a period of six years is 25.31 inches. The station comprises 3452 acres of land. The region served by this station is the Edwards Plateau region of Texas, and comprises an area where the Angora goat and sheep industries are highly centralized industries.

The purpose of the substation is to develop facts which can be used advantageously by the ranchman of this region in the conduct of his business. The major lines of work of this station are discussed under the following headings:

(1) Adaptation of Breeds of Sheep:

The Corriedale is being compared with the Rambouillet sheep in the study conducted in cooperation with the Bureau of Animal Industry of the U. S. Department of Agriculture, for the purpose of determining whether the Corriedale is adapted to Southwestern Texas range conditions. The Corriedale breed originated in New Zealand and is of comparatively recent origin. It is the result of fixing the type between the long- and fine-wool foundation. The Corriedale is a medium-wool breed of splendid mutton conformation and good shearing propensities. Although sufficient data have not been accumulated to justify conclusions, indications are that this breed is not so well adapted to Southwestern Texas range conditions as is the Rambouillet breed.

(2) Breeding Investigations:

Studies of type and inheritance in Rambouillet sheep, Angora goats, and the Hereford-Brahman cattle cross, respectively, are under way with a view of obtaining new information that will be useful in developing improved types and strains.

(3) Flock and Herd Management Studies:

Detailed records covering the several phases of live stock management, including per cent lamb, kid, and calf crop, death losses, shearing, and marketing methods are being accumulated with the view of placing this information at the disposal of those interested in the ranching business.

(4) Stomach Worms and Other Internal Parasites:

A study of the most effective methods of combating the ravages of the stomach worm in sheep and Angora goats has been under way during the past several years. The copper sulphate (bluestone) treatment has proved the most satisfactory for the treatment or range flocks for stomach-worm eradication.

(5, 6, 7) External Parasites Affecting Sheep and Goats:

A study of the control of the screw-worm fly, the wool-maggot fly and the several different kinds of goat lice is a cooperative study with

the Bureau of Entomology, U. S. Department of Agriculture. The fly repellents and worm killers are being studied as to their effectiveness. Several of the best live stock dips are being compared with reference to their efficiency as goat lice killers. The life history of the several kinds of goat lice is being studied in this cooperative project with encouraging prospects for complete eradication under proper systems of dipping. The study of the sheep-scab mite was undertaken in April, 1924. This is also a cooperative project with the Bureau of Entomology, U. S. Department of Agriculture. The life history of the scab mite is being carefully studied with the view of developing new facts in relation to the eradication of this parasite. In addition, a comparison of the effectiveness of the leading sheep dips in the destruction of the scab mite is being made.

(8) Swellhead:

This project is to study the cause of the condition among sheep and goats commonly known as bighead or swellhead. It has been comparatively inactive during the past two or three years on account of there being only a very limited occurrence of this condition.

(9) Soremouth:

Soremouth is a condition that may affect either mature sheep or lambs. The form of the disease most prevalent in Texas seems to more readily affect suckling lambs than older or mature sheep. One of the purposes of the study under way at Substation No. 14 is to ascertain the causes of the disease and the most effective curative agents.

(10) Range Vegetation Studies:

The problem in this study is to determine the character and economic importance of the native vegetation of the Edwards Plateau region for grazing purposes. The information developed in such a study should serve as a basis for a better utilization of the range vegetation of the region, and aid materially in developing a more profitable system of ranching for the area.

(11) Activities of Livestock:

The object of this project is to observe and record the behavior of live stock on the range with the view of obtaining definite information as to their requirements and their preferences for range forage.

(12) Carrying Capacity Studies:

The purpose of this study is to test a proposed rate of stocking for the Experiment Station ranch of 31 carrying-capacity units for cattle, 26 units for sheep, and 13 units for goats.

Substation No. 15, Weslaco

Substation No. 15 is located at Llano Grande Switch, Hidalgo County, and adjacent to the railroad and highway, about midway between Mercedes and Weslaco.

This station was established primarily for investigations of citrus fruits, vegetables, and allied crops farming. The study of insects and diseases common to citrus fruits and vegetables was also considered one of the important phases of the work of this station. The station comprises an area of 100 acres of land, composed of Victoria fine sandy loam. At the time of its establishment, the station had a 10-acre orchard of Marsh Seedless grapefruit, comprising about 1000 trees.

Of the 100 acres, 55 acres are devoted to experiments; 17 acres to field crops, and the remaining 28 acres to roads, laterals, farmstead, and pasture.

Of the land devoted to experiments, approximately 10 acres are devoted to the aged pomelo orchard; 10.8 acres to the young pomelo orchard; 6.3 acres to deciduous fruits; 15.3 acres to vegetables; 4.8 acres to the date plats; 1.6 acres to the introduction plats; 1.8 acres to nurseries; and 4.5 acres to field crop plats.

The aged grapefruit orchard is devoted to soil management, spraying, and fumigation work. The soil-management work indicates that both the quality and the quantity of fruit harvested from using cover crops and sod were less than in that harvested from trees given the usual cultural care. Very few of the fruits on the cover crops and sod plats graded as medium-sized fruit, being inferior to that having culture. Apparently moisture was the limiting factor in this instance. Winter cover crops of alfalfa and Canadian field peas did not produce this undesirable effect on the fruit, and it is likely that winter cover crops will be more practical for maintaining the humus content of the soil than are summer cover crops. It appears to be extremely difficult to get a sufficient penetration of irrigation water in sod orchards with the present methods of distributing water.

The fertilizer work conducted during the past year was not considered as very dependable owing to the fact that there seems to be quite as much variation between different trees of the same plat as there was between different plats.

The two freezes occurring in 1924 and 1925 have interfered somewhat with the results, making them unreliable as a measure of the benefits from the use of fertilizers. Further work will be necessary before definite information is available.

The use of oil sprays of several types has failed to give altogether satisfactory control of California Red Scale, owing to the difficulty in securing a thorough coverage. Tent fumigation of citrus trees was tested out on a rather large scale with fairly satisfactory results from the standpoint of percentage of kill secured. Reinfestation, however, has appeared on the earlier work to such an extent that commercial control will not be secured from a single treatment early in the season. Calcium cyanide dust gave poor results. An entirely satisfactory method for fumigating citrus trees has not as yet been worked out for Valley conditions.

The deciduous fruits orchard, comprising 6.3 acres and planted to a variety of deciduous fruits, has not yet developed to a stage where it can be used for experimental purposes.

The vegetable work, including lettuce, spinach, turnips, carrots, beets, cabbage, cauliflower, beans, rhubarb, peppers, tomatoes, strawberries, and cantaloupes, and embracing 15.3 acres, has shown that the New York or Wonderful variety of lettuce seems to be the most desirable variety tested, enduring unfavorable environmental conditions better than any other variety. The Big Boston was also a good producing variety, but not equal to the New York in quality and size. Soft rots and damage from wind-driven sand caused serious losses to lettuce this season.

Broad Leaved Flanders and Mammoth Viroflay produced more plants per pound of seed, a heavier tonnage of greens, and were slower in seeding than the check variety of spinach. These varieties are decidedly superior to the commonly grown Bloomsdale Savoy.

The Purple Topped White Globe variety of turnip was the most desirable type of any variety tested this season. Other varieties produced heavier tonnages of greens, but as a dual purpose type, the Purple Topped White Globe variety was distinctly superior. Aphids were found to be a limiting factor in turnip production in the Valley this year, but were controlled by the application of freshly made nicotine dust. This was found to be more effective than any of the several liquid sprays used.

The Chantenay variety of carrots produced the highest yield of marketable carrots of any variety tested this season. They were somewhat later than the Oxheart but produced 200 bushels more per acre than that variety. They were apparently more resistant to some of the soft rots which caused serious losses this season than were some of the other varieties.

Variation in the quality of beets within the same strain of commercial seed was found to be as great in some instances as the variation in the quality between different varieties. The type does not seem to be well fixed in any strains of Crosby's Egyptian beet offered for sale in the Valley. The Egyptian was found to be the desirable type for Valley planting, but several strains of Crosby's Egyptian beets were distinctly inferior when compared with better strains.

Marked differences were observed in the time and uniformity of heading by a number of commercial varieties of cabbage. The Golden Acre variety produced the highest yield of early marketable cabbage of desirable quality, but was excelled in total yield by the Glory of Enkhuizen variety. Black rot and black leg caused some losses this season.

Field plantings of a number of commercial varieties of cauliflower were made this season and the crop gave promise of exceptional growth until the freeze on December 27. The low temperature, coupled with the humid weather conditions immediately following caused the loss of the entire crop.

The Black Valentine bean gave the highest yield of any variety tested

this season, but was surpassed in quality by the Giant Stringless and Burpees' Stringless varieties. The Black Valentine was reported to be a better shipping bean than the other varieties, and is popular with the shippers when nearby markets are supplied with beans.

Seed of several commercial varieties of rhubarb were planted, but for some reason very few plants were secured. Last year the same method yielded a fair stand of plants. Giant winter varieties are best adapted to use as a winter crop in the Valley.

The Chinese Giant variety of pepper was found to be the most prolific producer of marketable peppers of any variety tested this season. The Pimento variety produced satisfactory yields this season, but was about two weeks later than the Chinese Giant variety. Anaheim Chili was found to be a very productive variety of hot chili pepper,—a pepper that is popular with the Mexican trade. Floral Gem and Spanish Gem were found to be very showy varieties, which could be used for ornamental purposes. The smooth, coral red pods are very attractive when plants are massed. Cutworms at transplanting time and pepper weevils later in the season were the two principal factors affecting the commercial production of peppers in this section.

A number of commercial varieties of tomatoes were studied rather closely this season in an effort to find a more desirable type of tomato for Valley use than the commonly grown strains of Livingston's Globe. During the season of 1925, no variety of tomato was studied which excelled the Globe variety in the several points considered essential by shippers of tomatoes. During the past season, the Louisiana Pink variety, and the Burpee's Self Pruning variety made very satisfactory yields of tomatoes of exceptional uniformity as regards size, shape, color, and freedom from air pockets, or "puffiness," as this condition is commonly called. Whether or not "puffiness" in globe-typed tomatoes is a heritable factor, or a condition due to environmental factors has yet to be determined.

The use of complete fertilizers at the rate of four hundred pounds per acre increased yields to a slight extent, and in some cases hastened maturity of the fruit. No correlation was observed between the amount of "puffiness" found in the fruit and the amount or kind of fertilizer used.

The Klondike and Progressive varieties of strawberries were found to be best adapted to Valley conditions. Several of the varieties tested could not endure the heat of the Valley summer. Frequent irrigation during the summer was found to be more important than shading in summering the plants over.

There is apparently a great deal of variation between commercial strains of the same variety of cantaloupes, as revealed by this season's tests. The commonly grown type, Pollock 10/25, was found to be a very hardy variety of fair quality. No variety was found to be entirely resistant to foliage diseases, but the Burrell's Superfecto variety was

found to be more resistant than a number of other varieties, and of distinctly superior quality.

The use of complete fertilizers increased the yield of marketable-sized cantaloupes, but did not hasten the maturity of the melons sufficiently to avoid losses from mildew. Vines remained more healthy on nitrate fertilized plats than on any of the other plats.

Spraying of cantaloupe vines with Bordeaux mixture with Ammoniacal Copper Carbonate kept vine diseases under control, but retarded the setting of fruit, and resulted in a dwarfing of the plants. Mixtures of copper salts and dry lime were of some benefit in controlling foliage diseases and injured the plants less than the liquid applications. Spraying with potassium sulphide solution gave results comparable to Bordeaux in controlling diseases and did not injure the plants too severely. Dry sulphur applied as a dust application to the soil under the vine offered some promise as a control measure for mildew. Aphids were a very important factor in cantaloupe production in the Valley this season.

Seedling dates from pedigreed seed obtained from the United States Date Gardens have been growing in station nurseries for two seasons and will be set on permanent locations this fall. Four bearing date palms of proven worth were purchased and set out on station property. Seven out of ten offshoots of commercial varieties of dates from the Indio Gardens were successfully rooted in station nurseries this season and will be moved to permanent location next year.

Plants of Athel (*Tamarix articulata*) have made very satisfactory growth and offer some promise as a plant for windbreaks.

Several varieties of jujubes fruited at the station this year and the size and quality of the fruit from some varieties were distinctly superior to some of the other sorts.

Plants of Rusk Citrange, Citradia, Citrangequat, and Meyer lemon were secured from the U. S. Department of Agriculture for use as root stock. Out of this lot, the only promising root stock is the Rusk Citrange. Some difficulty has been experienced in budding this stock to some of the commercial varieties of citrus.

The Meyer, or Dwarf lemon was found to be distinctly more resistant to cold than the commercial lemon and practically as resistant as the Satsuma orange. The Eustis Limquat was also found to be much more resistant to cold than the commercial lime, or practically as hardy as the Satsuma orange. This fruit has not yet been accepted by the commercial trade as a lime.

Fifty varieties of commercial sorts of citrus and strains of commercial varieties are being grown in station nurseries for setting out in orchard form this fall. One hundred and twenty trees of several varieties have been set in variety-test orchards. This lot includes one lot of varieties imported from South America by the U. S. Department of Agriculture.

Deciduous fruit plantings included five acres set to the more promis-

ing sorts of strawberries, blackberries, dewberries, grapes, peaches, plums, pears, persimmons, figs, olives, and pecans. A number of plants were received through the Office of Foreign Seed and Plant Introduction but very few of these have shown much promise up to the present time.

A variety of sorghum (*Masambra sorgo*), secured in May, 1925, offers some promise as a forage crop provided difficulties of seeding can be overcome. Canadian field peas and Berseem clover are two winter legumes of considerable promise for use as cover crops and for forage purposes in this section. New Laredo soy beans and mung beans produced yields of forage comparable to the best varieties of cowpeas. Germination of these beans was much better than that of the common soy beans.

Substation No. 16, Iowa Park

Substation No. 16 is located two and one-half miles southeast of Iowa Park, Wichita County, on the Fort Worth & Denver City Railroad: latitude 33 degrees 55 minutes north, and longitude 98 degrees 39 minutes west; elevation 974 feet. Annual average rainfall over a period of six years is 27.95 inches. The station comprises 161.79 acres of land. The soil is of the Miller and Yahola series, being typical of the Wichita Valley alluvial soils and of the valley soils of most of the rivers of Texas.

This station was established to serve an area of irrigated lands coming under the new Wichita Valley irrigation project. Not only will this station serve this irrigated region, but it is considered that the results secured will be applicable to other similar projects developed along the principal streams of Texas where the soils are similar to those existing in this project, and belong principally to the Miller and Yahola series.

This is the second crop season since the establishment of the station, the first crop season having been devoted very largely to developing the land and equipping the farm for experimental work. The station now has six well-constructed buildings, including the superintendent's residence, modern live stock barn, three laborers' cottages, implement shed, and other smaller structures. It has been necessary to construct a system of irrigation mains and laterals for supplying the land with water.

One of the big objectives of this station is to accumulate information as to the different farm enterprises, such as fruit growing, vegetable growing, field crops, grain, alfalfa, and the utilization of these crops in such a way as to round out a profitable farm enterprise under the conditions in the Valley. While the information contributed thus far is to be regarded strictly as preliminary and by no means conclusive, it will be of value to farmers.

The tests of cotton this year are based on only three varieties: Pedigreed Mebane, Mebane 804, and Acala 8. In the test on fine sandy loam, Pedigreed Mebane made a yield of 526 pounds, Mebane 804 a yield of 376 pounds, and Acala 8 a yield of 352 pounds. The test of the same varieties on heavy clay soils produced the following: Mebane 804,

Pedigreed Mebane. and Acala 8, 243, 422, and 393 pounds of lint, respectively. Thus it is seen that in the duplicate test, Pedigreed Mebane produced a much better yield of cotton than the other varieties tested. The Acala lint was in good demand, although considered more "wasty" than the Mebanes. The Pedigreed Mebane produced uniform length of lint, fully one inch in length.

Of the grain sorghums grown, Blackhul kafir 153 was apparently the most satisfactory crop of all, but as facilities are not available for weighing the crops, no relative weights were obtainable. Four varieties of alfalfa were planted, Hairy Peruvian, Common, Grimm, and Turkestan. The Hairy Peruvian seemed to be the best variety in point of yield and resistance to root-rot and general unfavorable conditions. Kanota oats produced three bushels more per acre than Red Rustproof. As a spring oat, the Kanota is slightly earlier than the Red Rustproof.

The Groit and the Chinese Red cowpeas were the best forage yielders of all the varieties tested. Mung beans and guar are well adapted to the conditions in this region, and since the latter crop is known to be resistant to root-rot and also known to be one of the best soil improvement crops, it may become an important crop here to maintain the soil in a high state of fertility. Soy beans were destroyed by rabbits.

Six varieties of field corn were planted but the yields were rather poor, owing to unfavorable weather conditions in June.

In the cantaloupe tests, Rockyford melons gave a yield of 140 crates of the 12 melon pack, while Honey Balls yielded 83 crates, and Cannon Ball, 346 crates of six melon pack. The Rockyfords seem to be unexcelled, both production and quality considered, Cannon Ball being a variety of relatively poor quality. Burrell's Gem was also a good variety, ranking second only to Rockyford.

Fruit and vegetable crops seem well adapted to the region for spring and fall crops. Turnips, beets, radishes, and carrots have made satisfactory growth. Lettuce, mustard, spinach, endive, and salsify made fair growth, but these tests were not considered as satisfactory or indicative of a normal crop. Cucumbers, squash, onions, and English peas are among the vegetables that have shown their adaptation for early spring crops in this section. Okra, black-eyed peas, and beets grow well through the spring and summer. The Copenhagen Market cabbage as a spring crop was ten days earlier than Early Jersey Wakefield and gave better yields. Sweet potatoes are an uncertain crop on account of cotton root-rot disease. Tomatoes, string beans, and sweet corn this year have been satisfactory crops. Irish Cobbler potatoes seem to produce a better crop than Triumph under the conditions here. Irish potatoes receiving barnyard manure produced double the amount of potatoes produced where only straw was used.

An orchard consisting of more than 400 fruit trees was set out in

the spring. This orchard contains varieties of peaches, apples, plums, prunes, and pears, some nectarines, hybrid fruits, apricots, and quince, and numerous other varieties. Thirty varieties of American grapes were planted.

A variety of ornamental and shade trees have been planted. The Chinese elm especially is making rapid growth, but it is affected somewhat by root rot.

Texas Root-Rot.—In view of the widespread infection of Texas root-rot in Wichita County and its increasing menace to profitable farming, the Valley Development Committee of the Wichita Fall Chamber of Commerce, in the spring of 1926, set aside a sum of money for use at Substation No. 16 in connection with investigations of this fungus disease. Investigations thus far have embraced a study of the prevalence and distribution of this disease on the different soil types; the variety of plants attacked; the control of root-rot of alfalfa; percentage of root-rot in cotton; and the selection and shipment of root-rot specimens for examination.

Thus far no accurate figures are available showing to what extent one type of soil harbors the disease over that of any other soil, but, in general, it is thought that sandy soils are less affected than are the heavier soils. From information and observations available, root-rot occurs to a limited amount on practically every soil type in Wichita County. Observations have been made during the past three seasons regarding the location of root-rot, and, while as a rule it is thought that sandy soils are less affected than are the heavier soils, indications here show some very large spots of root-rot on soils of the coarsest texture. Likewise, on heavy clay loams, large areas die from root-rot, and alfalfa has been known to die out almost completely in two seasons on such soils.

From an economic standpoint, cotton is the crop most seriously affected in this region, the damage being perhaps between two and four per cent. Alfalfa, though grown to a negligible extent here, has shown a high susceptibility to the disease. While clover, cowpeas, peanuts, mung beans, field beans, and sugar beets are also affected. Guar has been found to be highly resistant to root-rot. Many shade trees, including the Chinese elm, the cottonwood, weeping willow, sycamore, silver maple, and redbud are susceptible to the disease. Carrots, beets, okra, sweet pepper, string beans, and black-eyed peas have been observed as being affected by root rot in this section. Sweet potatoes are also affected.

The work with alfalfa at this station, planned to cover a period of five years or more, with a view of determining the effect of susceptible weed carriers and clean fallow in the spread and in the control of root-rot in alfalfa will provide an opportunity for observing the effect of winter and summer weeds as carriers of the disease, and also the behavior of this disease under different cultural methods.

Such advice or information as has been available has been furnished to the different agricultural agencies and others interested in the control of this disease and there are many evidences that the farmers are making use of this information. In a number of cases, the use of rotation wherein some crop of the grass family, such as wheat, oats, or sorghum has been sown upon soil where cotton has failed on account of root-rot, has insured a profitable crops.

FIELD DAY MEETINGS AT SUBSTATIONS

On August 17 and 18, 1926, the Second Annual Texas Ranchmen's Round-up was held at Substation No. 14, Sonora. There were at this meeting about 2000 persons. A number of ranchmen traveled more than 200 miles to attend this meeting.

On August 23, 1926, the Annual Field Day meeting was held at Substation No. 12, Chillicothe. More than 450 farmers, county agents, and other business men were present.

On May 21, 1926, the Annual Field Day meeting was held at Substation No. 6, Denton, at which a large attendance of farmers and other citizens of the North Texas wheat-growing section was had.

On September 17 and 18, 1925, a farmers' meeting held at Substation No. 8, Lubbock, was well attended by a representative group from eight adjoining counties.

The "Feeders' Day" meeting at Substation No. 7, Spur, held on March 5, 1926, at the conclusion of the cattle and lamb feeding investigation was one of the best attended meetings the station has had. A large delegation from adjoining counties was present. The meeting was well covered by newspaper men and a great deal of publicity was given the work.

STATION LANDS

The following table shows the lands owned and operated by the Agricultural Experiment Station System of the Agricultural and Mechanical College of Texas, for agricultural research purposes:

Designation	Acres of Land Devoted to Various Uses			
	Area	Cultiva- tion	Pasture	Farmstead, Roadways and Mis- cellaneous
Total.....	8,121.395	1,638.53	6,295.695	197.32
Main Station Farm.....	*127	98	11	18
Division of Veterinary Science.....	*141	5	130	6
State Apicultural Research Laboratory, San Antonio, Bexar County.....	10	4.5	4.5	1
Loin Disease Field Laboratory, Bammel, Harris County.....	†1400.9	0	1398.9	2
Substation No. 1, Beeville.....	151.5	63.2	84.3	4
2, Troup.....	152.6	62.5	84	6.1
3, Angleton.....	159.3	58	98	3.3
4, Beaumont.....	100	67	4	29
5, Temple.....	96	33	60	3
6, Denton.....	209.92	157	44	8.92
7, Spur.....	406.35	265	131.5	10
8, Lubbock.....	160	122	38	10
9, Balmorhea.....	200	80	110	10
10, College Station.....	†901.8	240	630	31.8
11, Nacogdoches.....	81.6	35.4	36	10.2
12, Chillicothe.....	100	85	5	10
14, Sonora.....	3,461.63	59.93	3,381.7	20
15, Weslaco.....	100	95	3	2
16, Iowa Park.....	161.795	108	41.795	12

*Included in the main tract of College land.

†Leased land.

‡Includes 636 acres of the College's main tract and 265.8 acres purchased later for research purposes.

COOPERATION

In accordance with the long-established policy of the Texas Station to cooperate wherever cooperation may be mutually desirable, formal agreements providing for cooperative research have been entered into or continued during the year as follows:

1. Office of Forage Crops, Bureau of Plant Industry, United States Department of Agriculture, in the operation of Substation No. 12, Chillicothe, Texas, and in general forage crops throughout the State.
2. Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, United States Department of Agriculture, for the introduction, propagation, and distribution of newly introduced plants which give promise of becoming valuable in Texas.
3. Office of Cotton and Truck-Disease and Sugar-Plant Investigations, Bureau of Plant Industry, United States Department of Agriculture, for an annual plant disease survey in Texas and for a general study of plant diseases.
4. Bureau of Soils, United States Department of Agriculture, for the conduct of soil survey work in Texas.
5. Bureau of Entomology, United States Department of Agriculture, for co-operative investigations of insects and parasites affecting livestock.
6. Bureau of Animal Industry, United States Department of Agriculture, for investigations as to the adaptability of Corriedale sheep to Texas conditions, the study of soft pork problems, and cattle feeding and killing qualities.
7. Bureau of Agricultural Economics, United States Department of Agriculture, for studies of farmers' and ranchmen's business organizations and in

making an agricultural economic survey of a typical crop-farming area in the blacklands of Texas.

8. Freeport Sulphur Company, in furnishing funds and material for the study of sulphur as a fertilizer, as an insecticide, and as a fungicide.
9. The Barrett Company of Texas, for cooperation in fertilizer work with rice by furnishing fertilizer materials.
10. School of Agriculture, Agricultural and Mechanical College of Texas, wherein Station men may give lectures to students and teachers may do co-operative investigation work for the Station.
11. School of Veterinary Medicine, Agricultural and Mechanical College of Texas, whereby the Dean of the School of Veterinary Medicine acts as Chief of the Division of Veterinary Science for the Station.
12. School of Engineering, Agricultural and Mechanical College of Texas, wherein certain professors may cooperate with the Station workers in agricultural studies involving engineering problems.
13. Extension Service, Agricultural and Mechanical College of Texas, whereby Extension service workers from time to time suggest the more important problems confronting Texas farmers and stockmen and certain Extension specialists cooperate with the Station in making certain investigations mutually agreed upon.
14. Williamson County Belton Cotton Seed Growers Association of Granger, Texas, for the increase and distribution of seed of pure Belton cotton.
15. Denton County Pure Seed Association, for the increase and distribution of outstanding strains of small grains, particularly Denton wheat and Nortex oats.
16. Texas State Livestock Sanitary Commission, in studies of the sheep scab mite at the Ranch Experiment Station.
17. Western Weighing and Inspection Bureau of Dallas, wherein the railroads of the State and Southwest furnish a fund for the conduct of research and investigations of the various transit and storage diseases affecting fruits, vegetables, and other field crops.
18. The Texas Cotton Seed Crushers Association, in furnishing cotton seed feeds in connection with utilization studies with cotton seed products.
19. The King Ranch, in cattle feeding studies, in which the King Ranch, Kingsville, Texas, has furnished cattle, feeds, and labor used in feeding work studies by this Station and the Bureau of Animal Industry.
20. The Wichita Falls Chamber of Commerce, in the support of cotton root rot investigations in which the Chamber of Commerce, Wichita Falls, Texas, has donated funds for labor to be used in connection with cotton root rot studies at Substation No. 16, Iowa Park.

FINANCIAL STATEMENT, TEXAS AGRICULTURAL EXPERIMENT STATION

COLLEGE STATION, TEXAS, November 20, 1926.

Acting Director A. B. Conner, Texas Agricultural Experiment Station System.

DEAR SIR: I do hereby certify that to the best of my knowledge and belief the following report upon the receipts and disbursements of the several funds devoted to the development, maintenance and support of the Texas Agricultural Experiment Station System correctly reflects the official accounts for the fiscal year ending August 31, 1926.

(Signed) M. P. HOLLEMAN, JR.,
Chief Clerk (Bonded).

Subscribed and sworn to before me, J. M. Schaedel, Notary Public in and for Brazos County, Texas, on the 20th day of November, A. D. 1926.

(Signed) J. M. SCHAEDEL,
Notary Public in and for Brazos County, Texas.

(SEAL)

FUNDS AVAILABLE

Total.....	\$ 555,806.44
Hatch Fund, from United States Treasurer for the year ending June 30, 1926..	15,000.00
Adams Fund, from United States Treasurer for the year ending June 30, 1926..	15,000.00
Purnell Fund, from United States Treasurer for the year ending June 30, 1926..	20,000.00
Main Station, from State Treasurer for the year ending August 31, 1926.....	146,578.82
Main Station, from State Treasurer (unexpended balance from the year ending August 31, 1925).....	2,358.51
Substations, from State Treasurer for the year ending August 31, 1926.....	123,470.00
Substations, from State Treasurer (unexpended balance from the year ending August 31, 1925).....	379.98
Substations, from State Treasurer (unexpended balance in establishment fund, Lower Rio Grande Valley Station).....	8.76
Main Station Treasury, from sale of products for the year ending August 31, 1926, including balance brought forward.....	34,996.81
Substation Treasury, from sale of products for the year ending August 31, 1926, including balance brought forward.....	86,057.48
Feed Control Service, from sale of Tags for year ending August 31, 1926.....	111,956.08

CLASSIFICATION OF EXPENDITURES

Total.....	\$ 555,806.44
Salaries.....	\$ 198,957.40
Labor.....	66,584.57
Postage, stationery, and office supplies.....	9,553.92
Scientific supplies (consumable).....	5,224.55
Feeding stuffs.....	20,170.61
Sundry supplies.....	8,388.54
Travel expense.....	30,539.67
Freight and express.....	3,645.42
Publications.....	6,426.16
Heat, light, water, and power.....	5,585.30
Furniture, fixtures, and furnishings.....	3,825.67
Library.....	413.31
Scientific equipment.....	10,501.23
Livestock.....	5,456.16
Farm machinery, tools, and implements and repairs thereon.....	12,982.10
Buildings and building repairs.....	36,642.35
Refunds on feed tax tags redeemed.....	157.21
Chemical analyses.....	12,000.00
Feed tags purchased.....	11,467.75
Contingent expenses.....	10,223.92
Feed Control surplus remitted to Treasurer of College.....	51,297.34
Reverted to State Treasury (1924-25 unexpended balance).....	445.10
Unexpended balance (as of August 31, 1926).....	45,318.16

ANALYSIS OF UNEXPENDED BALANCE OF AUGUST 31, 1926

Total.....	\$ 45,318.16
Main Station Appropriation.....	\$ 12,011.73
Substation Appropriation.....	3,389.91
Main Station Sales Fund.....	10,799.41
Substation Sales Fund.....	19,117.11

FEDERAL FUNDS

Total	\$ 50,000.00
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HATCH FUND

Items	Debit	Credit
Total	\$ 15,000.00	\$ 15,000.00
Received from Treasurer of the United States	\$ 15,000.00	
Salaries		\$ 14,071.58
Labor		262 10
Stationery and office supplies		352.09
Sundry supplies		11.05
Transportation of things		1.01
Furniture, furnishings, and fixtures		120.37
Repairs and buildings		181 80

ADAMS FUND

Items	Debit	Credit
Total	\$ 15,000.00	\$ 15,000.00
Received from Treasurer of the United States	\$ 15,000.00	
Salaries		\$ 13,276.54
Labor		546.13
Stationery and office supplies		50.22
Scientific supplies (consumable)		419.34
Feeding stuffs		355.47
Sundry supplies		108.14
Transportation of things		82.35
Heat, light, water, and power		38.34
Scientific equipment		121.17
Tools, machinery, and appliances		2.30

PURNELL FUND

Items	Debit	Credit
Total	\$ 20,000.00	\$ 20,000.00
Received from Treasurer of the United States	\$ 20,000.00	
Salaries		\$ 4,076.85
Labor		2,511.47
Stationery and office supplies		375.68
Scientific supplies (consumable)		419.95
Feeding stuffs		252.06
Sundry supplies		299.03
Travel expenses		611.57
Transportation of things		218.32
Furniture, furnishings, and fixtures		2,460.01
Library		107.00
Scientific equipment		6,874.42
Livestock		109.31
Tools, machinery, and appliances		196.95
Buildings and repairs		1,487.38

STATE APPROPRIATIONS

MAIN STATION

Division	Debit	Credit
Total	\$ 146,578.82	\$ 146,578.82
Received from State Treasurer.....	\$ 146,578.82	
Salaries.....		\$ 52,388.14
Administrative.....		8,157.28
Veterinary Science.....		5,137.90
Horticulture.....		3,754.35
Range Animal Husbandry.....		6,416.03
Entomology.....		3,825.42
Foul Brood.....		8,751.17
Agronomy.....		3,843.56
Plant Pathology and Physiology.....		2,912.22
Soil Survey.....		8,810.00
Farm and Ranch Economics.....		6,470.92
Botany.....		230.88
Publications.....		3,051.13
State Apicultural Research Laboratory.....		10,906.53
Main Station Farm.....		7,411.56
Reserve.....		2,500.00
Balance unexpended (vouchers pending).....		12,011.73

MAIN STATION

Division	Debit	Credit
Total	\$ 2,358.51	\$ 2,358.51
Received from the State Treasurer (unexpended balance from 1924-25 appropriation).....	\$ 2,358.51	
Salaries.....		
Administrative.....		\$ 0.59
Publications.....		2,105.67
Horticulture.....		
Range Animal Husbandry.....		
Entomology.....		
State Apicultural Research Laboratory.....		
Agronomy.....		
Main Station Farm.....		
Plant Pathology and Physiology.....		
Soil Survey.....		
Botany.....		
Reverted to State Treasury.....		252.25

STATE APPROPRIATIONS—Continued

SUBSTATIONS

Substations	Debit	Credit
Total.....	\$ 123,470.00	\$ 123,470.00
Received from the State Treasury.....	\$ 123,470.00	
No. 1, Beeville.....		\$ 5,299.61
2, Troup.....		4,645.24
3, Angleton.....		5,550.00
4, Beaumont.....		5,529.51
5, Temple.....		4,699.80
6, Denton.....		5,649.75
7, Spur.....		7,496.82
8, Lubbock.....		7,081.44
9, Balmorhea.....		7,802.93
10, Feeding and Breeding Station, College Station.....		6,297.95
Dairy section.....		1,599.93
Poultry section.....		2,747.82
Swine section.....		4,376.80
11, Nacogdoches.....		4,672.71
12, Chillicothe.....		4,697.75
14, Sonora.....		12,941.37
15, Weslaco.....		10,291.95
16, Iowa Park.....		18,698.71
Balance unexpended (vouchers pending).....		3,389.91

SUBSTATIONS

Substations	Debit	Credit
Total.....	\$ 379.98	\$ 379.98
Received from the State Treasurer (unexpended balance from 1924-25 appropriation).....	\$ 379.98	
No. 1, Beeville.....		\$ 1.50
4, Beaumont.....		23.81
5, Temple.....		
6, Denton.....		
7, Spur.....		
8, Lubbock.....		
9, Balmorhea.....		
10, Feeding and Breeding Station, College Station.....		
Dairy section.....		
Poultry section.....		
Swine section.....		
11, Nacogdoches.....		
12, Chillicothe.....		
14, Sonora.....		87.53
15, Weslaco.....		51.97
16, Iowa Park.....		28.05
Reverted to State Treasury.....		181.09

STATE APPROPRIATIONS—Continued

STATION

Lower Rio Grande Valley Station Establishment
Appropriation

Station	Debit	Credit
Total	\$ 8.76	\$ 8.76
Received from State Treasurer (unexpended balance August 31, 1925)	\$ 8.76	
Reverted to State Treasury		\$ 8.76

SALES FUNDS

MAIN STATION TREASURY

Division	Debit	Credit
Total	\$ 34,996.81	\$ 34,996.81
Balance brought forward from previous year	\$ 5,813.29	
Received from sales during year	29,183.52	
Veterinary Science		\$ 1,054.10
Horticulture		318.72
Chemistry (Analysis Fund)		12,466.63
Entomology		54.39
Entomology Certificate Fund		48.25
State Apicultural Research Laboratory		850.59
Agronomy		21.63
Main Station Farm		1,120.02
Plant Pathology and Physiology		2,697.65
Farm and Ranch Economics		782.43
Photographic Laboratory		1,394.23
Interest and Discount		410.96
Sulphur Fund		2,852.86
Main Station Auto Fund		115.29
Publications		9.65
Farm Bureau Fund		
Balance		10,799.41

SALES FUNDS—Continued

SUBSTATION TREASURY

Station	Debit	Credit
Total.....	\$ 86,057.48	\$ 86,057.48
Balance brought forward from previous year.....	\$ 7,534.74	
Received from sales during year.....	78,522.74	
No. 1, Beeville.....		\$ 1,715.42
2, Troup.....		319.56
3, Angleton.....		1,761.25
4, Beaumont.....		1,160.51
5, Temple.....		1,378.63
6, Denton.....		1,789.05
7, Spur.....		6,012.36
8, Lubbock.....		3,166.09
9, Balmorhea.....		3,373.73
10, Feeding and Breeding Station, College Station.....		1,881.31
Dairy section.....		7,906.27
Poultry section.....		5,679.41
Swine section.....		3,749.70
11, Nacogdoches.....		408.95
12, Chillicothe.....		1,727.18
14, Sonora.....		14,267.67
15, Weslaco.....		2,988.99
16, Iowa Park.....		1,772.47
Wool Scouring Plant.....		3,607.33
Soil Survey.....		1,049.69
Administrative.....		694.80
Ten Per Cent Fund.....		410.00
Wichita Falls Chamber of Commerce Fund.....		120.00
Balance.....		19,117.11

FEED CONTROL SERVICE

Item	Debit	Credit
Total.....	\$ 111,956.08	\$ 111,956.08
Receipts.		
Tax collected (inspection tax tags).....	\$ 111,956.08	
Disbursements.		
Salaries.....		\$ 22,265.87
Labor.....		1,510.00
Postage, stationery, and office supplies.....		1,776.49
Freight and express.....		267.96
Travel expense.....		9,318.21
Furniture and fixtures.....		615.50
Tags bought.....		11,467.75
Refunded on redeemed tags.....		157.21
Repair on Buildings.....		10.39
Publications (annual bulletin).....		1,269.36
Chemical analyses.....		12,000.00
Net surplus.....		51,297.34

INVENTORY VALUATION

Grand total valuation of properties used by Agricultural Experiment Station System.....		\$1,099,582.42
Owned by Station System and carried on Station Inventory.....	\$ 960,132.73	
Owned by College proper and carried on College Inventory, but used by Station System for Station purposes.....	139,449.69	

STATION SYSTEM PROPERTY

Total inventory valuation.....		\$ 960,132.73
Main Station.....	\$ 223,242.29	
Substations.....	736,890.44	

MAIN STATION

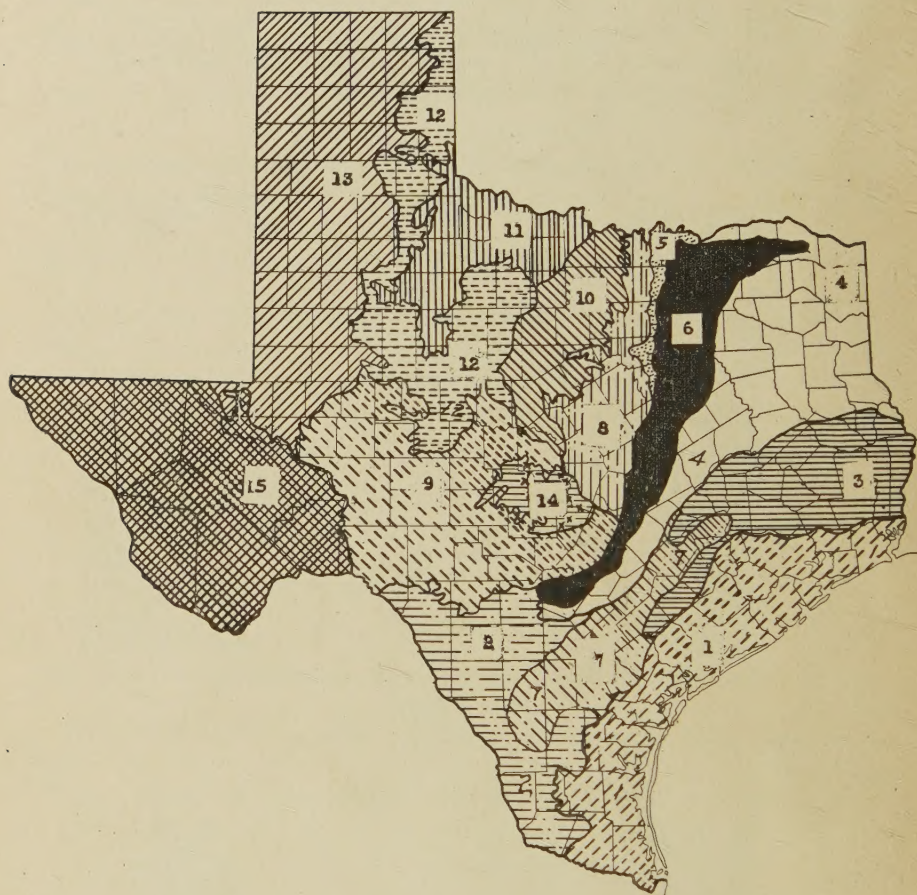
Total.....		\$ 223,242.29
Administrative.....	\$ 42,245.41	
Veterinary Science.....	31,409.42	
Horticulture.....	20,120.94	
Range Animal Husbandry.....	20,695.63	
Entomology.....	8,457.17	
Agromony.....	9,444.35	
Plant Pathology and Physiology.....	7,502.11	
Soil Survey.....	969.85	
Farm and Ranch Economics.....	2,589.64	
Botany.....	1,881.14	
Publications.....	6,167.85	
State Apicultural Research Laboratory.....	19,561.40	
Main Station Farm.....	33,318.01	
Chemistry.....	12,763.16	
Photographic.....	2,762.11	
Feed Control Service.....	3,354.10	

SUBSTATIONS

Total.....		\$ 736,890.44
No. 1, Beeville.....	\$ 27,162.34	
2, Troup.....	35,810.34	
3, Angleton.....	21,558.59	
4, Beaumont.....	27,801.40	
5, Temple.....	29,192.22	
6, Denton.....	42,753.80	
7, Spur.....	60,605.55	
8, Lubbock.....	37,421.31	
9, Balmorhea.....	27,246.93	
10, Feeding and Breeding Station, College Station.....	66,155.14	
Dairy section.....	22,110.00	
Poultry section.....	9,859.60	
Swine section.....	10,230.73	
11, Nacogdoches.....	24,924.91	
12, Chillicothe.....	26,821.85	
14, Sonora.....	130,859.73	
15, Weslaco.....	92,428.33	
16, Iowa Park.....	43,947.67	

SOIL REGIONS OF TEXAS

(Prepared by W. T. Carter)



- | | |
|--|---|
| 1. Gulf Coast Prairie | 9. Edwards Plateau |
| 2. Rio Grande Plain | 10. Western Cross Timbers and Association Interior Prairies |
| 3. Flatwoods Region | 11. Northwest Texas Red Lands |
| 4. East Texas Timber Country | 12. Northwest Texas Dark Soils |
| 5. Eastern Cross Timbers | 13. High Plains (Llano Estacado) |
| 6. Black Waxy Prairie Lands | 14. Central Mineral Basin |
| 7. Interior Black Prairie Lands | 15. Trans Pecos Region (Mountains and Plains) |
| 8. Fort Worth Prairie and Lampasas Cut Plain | |